THE

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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Pestalozzi.

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CHAPTER II.

FROM the breaking up of the establishment at Neuhof in 1780, eighteen years elapsed before Pestalozzi again attempted to keep a school.

First Writings.

His existence during that period was depressed, poverty-stricken, and at times almost precarious; but it afforded him plenty of leisure for thinking out and maturing his ideas, and making them known to the world by his writings. He was the author of several works, but of these three only need be remembered: it was by them that his reputation was gradually established, and Pestalozzi came to be recognised as the foremost educational thinker and reformer of his time. The names of these works are (1) 'The Evening Hours of a Hermit,' (2) 'Leonard and Gertrude,' and (3) 'How Gertrude Teaches her Children.' The last of these three will be spoken of in its place, later on. The first, which appeared immediately after the collapse of the Neuhof School, was a short paper in the 'Ephemerides,' a journal edited by Iselin, Recorder of Bâle, wherein he states the results of his experience as a teacher, and his views of what education should be. It is neither more nor less than a series of aphorisms, disconnected in form, and altogether destitute of literary skill and arrangement, but bound together by close unity of thought, intention, and subject-matter. They are the fruits of his past experience and reflection, but they contain the seeds of all his future labours and achievements in the cause of education. 'The Ephemerides of 1870,' so he writes some twenty years later, at the zenith of his fame, 'bear witness that the dream of my desires is not more comprehensive now than it was when at that time I first sought to realise it.'

The general tone and character of the 'Evening Hours' may be gathered from a few extracts:—

'All mankind are by nature alike,—they have but one path to contentment,—the natural faculties of each are to be perfected into pure human wisdom.

'The faculties grow by exercise.

'The intellectual powers of children must not be urged on to remote distances before they have acquired strength by exercise in things near them.

'The circle of knowledge begins close round a man, and from thence stretches out concentrically.

'Real knowledge (*i.e.*, knowledge of facts acquired by experience) must take precedence of word-teaching.

'As the education for the closest relations comes before the education for more remote ones, so must education in the duties of family membership come before education in the duties of citizenship. But nearer than father or mother is God: the closest relation of mankind is their relation to Him.

'Faith in God is the confiding child-like feeling of mankind towards the paternal mind of the Supreme Being. This faith is not the result of cultivated wisdom, but an instinct of simplicity; a childlike and obedient mind is not the consequence of a finished education, but the early and first foundation of human culture. Out of the faith in God springs the hope of eternal life. Children of God must be immortal.

'Belief in God sanctifies and strengthens the tie between parents and children, between subjects and rulers; unbelief loosens all ties, annihilates all blessings.

'Sin is the source and consequence of unbelief; it is acting contrary to the inward witness of right and wrong,—the loss of the childlike mind towards God.

'The loss of this childlike feeling of mankind towards God is the greatest misfortune of all the world; it renders all paternal education on the part of God impossible.

'The restoration of this lost childlike feeling is the redemption of the lost children of God on earth.

'The Son of God, who by suffering and death has restored to mankind the lost feeling of filial love towards God, is the Redeemer of the world; He is

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the sacrificed Priest of the Lord; His Mediator with sinful man. His doctrine is pure justice, educative national philosophy; the revelation of God the Father to the lost race of His children.'

'Each of these aphorisms,' says one of Pestalozzi's biographers, 'is a text for a discourse; indeed, Pestalozzi's whole life is a paraphrase in act of these texts. We must lay it to the account of human infirmity, if the realisation of his grand anticipations turns out but miserably, nay, only too often stands in glaring contradiction with them. The plan of an inventive architect retains its value even if the architect himself lacks the skill to carry out the building according to the plan.'

Leonard and Gertrude.

Up to this time, and indeed after the publication of his 'Evening Hours,' Pestalozzi appears to have been unconscious of the possession of any literary ability. And even when destitution stared him in the face, and he was compelled to look about for the means of subsistence, it was at the suggestion of a friend that he first tried his hand at authorship. He composed five or six stories, most of which have been long since forgotten, on the plan of Marmontel's 'Moral Tales;' but the last of these, to which he gave the title of 'Leonard and Gertrude,' was the foundation of all his future fame. It was written: as it were, in a vein of inspiration, and without effort. 'The story,' says he, 'flowed from my pen I know not how, and developed itself of its own accord, without my having any plot in my head, or even thinking of one. In a few weeks the book was there, without my knowing exactly how I had made it. I felt its value, but only as a man in his dreams feels the value of some piece of good fortune. I was hardly conscious that I was awake, and yet a new ray of hope began to dawn upon me when I thought that it might be possible in this walk to improve my pecuniary condition, and to make it more supportable to my family.' A friend to whom he showed his MS. pronounced it interesting, but at the same time so insufferably incorrect in language and unpolished in style that it was out of the question to publish it, and suggested that it should be previously revised by some practised writer. 'With no more pretension than a child,' Pestalozzi handed over the MS. to the individual recommended, but, 'what was my astonishment,' says he, 'on receiving the revision! It was a regular piece of divinity student's work, which completely changed the real picture of peasant life, simply and artlessly portrayed by me from nature, into something full of formality and affectation; and made the country-folk at the inn speak a stiff pedagogic language which did not leave a vestige of the peculiarity of my book.' In high dudgeon he betook himself to his former friend Iselin, and timidly tried to gain his sympathy by telling him the story of his wrongs. 'But Iselin's opinion and his conduct,' Pestalozzi goes on to say, 'exceeded all my expectations. He said directly he saw the MS. of the work, "There is nothing like it of its kind, and the views which it advocates are an urgent necessity of our time. As for its defective orthography, that is a matter of minor importance and can soon be set to rights. I will arrange for the publication of the book, and see that you are fittingly remunerated."' Pestalozzi received a louis d'or* per sheet, and a louis d'or per sheet seemed like wealth to him in his then destitute condition. When the book appeared, the impression produced by it was extraordinary, extending far beyond the borders of Switzerland. Periodicals reviewed it, the almanacs quoted it; it was discussed in every society, and the Agricultural Association of Berne presented the author with their great gold medal of honour, accompanied with a letter of thanks. 'Pleased as I was with the medal,' he writes, 'and glad as I should have been to keep it, I was nevertheless compelled to part with it, and sold it at a goldsmith's for its value in money.'

* = 24 francs, or a little less than a sovereign.

The object of the book was, as Pestalozzi himself explains it, 'to bring about a better popular education, based upon the true condition of the people and their natural relations. It was my first word to the heart of the poor and destitute in the land. It was my first word to the heart of those who stand in God's stead to the poor and destitute of the land. It was my first word to the mothers of the land, and to the heart which God gave them, to be to theirs what no one on earth can be in their stead.'

The chief character in the story is Gertrude, the wife of the easy-going nonentity Leonard, and the pillar of his house. Gertrude is the embodiment of Pestalozzi's ideal of the housewife and mother, and the way in which she brings up her children is the way in which he would have all children brought up. Her character and her influence are the lights of the picture, which, on the whole, is a melancholy one, with the sombre background of a peasant community sunk in the deepest depravity.

It was in the endeavour to raise the labouring classes of his countrymen out of this condition by good elementary instruction, that Pestalozzi now recognised the work of his life. 'I desire nothing, and desire nothing else as the object of my life, but the welfare of the people, whom I love, and whom I feel to be miserable as few feel them to be miserable, having, with them, borne their sufferings as few have borne them.'

The friends who surrounded Pestalozzi seemed to have welcomed the success of his book chiefly as a proof that he would be able henceforward to earn his bread as a writer of fiction, ignoring altogether the purpose of the work, and the teachings of the experience which had cost him so dear. But others at a distance showed a deeper insight: invitations reached him from Savoy, from Austria, and from Italy, to settle in those countries, and the offer of a high appointment was made to him by the Grand Duke of Tuscany. The warmest admirer of Pestalozzi will hardly regret that circumstances occurred to prevent his being placed in a position of official or pecuniary responsibility. Lavater, who knew, loved, and appreciated him, is reported to have said one day to his wife, 'If I were a prince, I would consult your husband in everything that concerns the people and the improvement of their condition, but I would never trust him with a farthing of money.'

Of the other works of Pestalozzi published between 1780 and 1798 it would be unprofitable to speak to English readers. During the whole of that period he was a philosopher and a theorist, but in 1798, the memorable epoch of the great French Revolution was to him, as to so many individuals and communities,

the turning-point of a career. The revolutionary armies of France overran Switzerland, sweeping away the existing form of government, and all the Swiss cantons were consolidated into 'one indivisible republic,' under five directors, after the French model. Of these directors one, who was named Legrand, was a personal friend of Pestalozzi, and offered him his choice of an employment under the new government. 'I will be a SCHOOLMASTER,' was his reply.

At Stanz, 1798-9.

On the 9th of September, 1798, Stanz, in Unterwalden, on the Lake of Lucerne, was destroyed by the French, and the whole surrounding district laid waste with fire and sword; in consequence of which a multitude of fatherless and motherless children were left unsheltered and uncared for in the devastated villages and farms. Legrand now called upon Pestalozzi to repair to the ruins of Stanz, and to create a home and an asylum for the orphans there.

Accompanied by a single woman-servant, he took up his abode in the great Ursuline convent, which was set apart for his use by the authorities, but in a condition quite unfit for the accommodation of a number of children. Gradually he gathered round him as many as eighty wastrels from four to ten years old, 'horribly neglected, infected with itch and scurvy, and swarming with vermin;' their low-browed and inexpressive physiognomy and malign aspect affording a sure index of the mental darkness, the stubborn temper, the hopeless spirits, and the vicious habits on which the teacher would have to work. Not one in ten of them could say the alphabet.

Such were the conditions of this 'educational experiment,' which Pestalozzi regarded as 'a sort of feeler of the pulse of the science which he wanted to improve.' A venturesome effort, indeed! 'A man with the use of his eyes would certainly not have ventured it; fortunately I was blind.'

Pestalozzi gained much of his unrivalled knowledge of children's nature from the Stanz 'experiment,' which can hardly be called a failure, though it came to an end in less than a twelvemonth, and though his unsupported and unaided exertions in giving it a fair trial almost brought him to the brink of the grave. He was not only the teacher and trainer of those eighty children, but 'paymaster, man of all work, hospital nurse, and almost housemaid,—all at the same time; all the help,' says he 'given them in their need, all the teaching they received, came from me; their food was mine, and their drink was mine. I slept in the midst of them; I was last to go to bed at night, the first to rise in the morning.'

From this slavery he was emancipated just in time to save his life, by a change in the fortunes of war. The French army, hard pressed by the Austrians, fell back upon Stanz, and established a military hospital in the convent of the Ursulines. The scholars of Pestalozzi were turned out and dispersed, and he himself went up into the mountains, not so much to rest as to recruit his energies for fresh efforts.

(To be continued.)

How to teach the Babies.

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CHAPTER XIII.

SINGING: PHYSICAL EXERCISES: CONCLUDING HINTS.

Singing.—The value of Singing as an instrument in the training of children, is now universally recognised. As a physical exercise, when discreetly managed it is highly conducive to health and to cheerfulness, and in every stage of school life it exerts great power in relieving the strain and pressure of its more severe work. As a disciplinary agent its influence is equally strong and equally valuable. It calms excitement, it promotes unity of feeling and of action, giving oneness and pleasantness of tone throughout the class or the school, and, like music to marching, it infuses spirit and life, as well as regularity, to what, without it, is a mere mechanical exercise. And 'the younger children are, the more and the more frequent the necessity for the relaxation thus afforded; there can be no successful management of the infant school without it' (Currie). The babies' class therefore must have much of it; but the words, the tune, and the whole method of it, must be rightly adapted.

The teaching of Singing necessarily involves the teaching of the words, and the teaching of the music or tune to which the words are set. But it by no means implies that these two parts of the one subject need be, or indeed ought to be taught at the same time. It is only in a somewhat advanced stage of instruction that the combined process can be taken at the beginning without difficulty or confusion. The effort of attention and intelligence necessary to learn the words is quite a sufficient tax upon the powers of young children, without having at the same time to make the further effort involved in learning the tune. The tune, too, can be learnt, as a rule, with much greater precision and ease when sung to the same syllable throughout, than when joined with the words.

In the choice of school songs for the little ones, regard must be had to the suitability of subject and of style. Whether sacred or secular the words and style should be simple, and the subject such as comes fairly within the range of the children's knowledge and sympathies. There is no lack of such, either humorous or serious, descriptive or more directly instructive. In number and variety there is a sufficiently ample choice of pretty, sensible, and suitable pieces, to make it quite unnecessary to resort to the silly, unmeaning words sometimes employed under the plea of their simplicity. In addition to the hymns used for worship in the opening and closing exercises of the school, and in connection with the scripture lessons, school songs will be wanted for singing before and after the various lessons, for singing during the marching and the ordinary physical exercises, and also some special 'Action Songs.' The words of these songs should be carefully taught, apart from the singing of them; with simple and interesting explanation of their meaning. They form, indeed, simple recitation exercises of no mean value, either as exercises for the memory, or as a means of training.

The little ones should be taught to sing them chiefly by the process of imitating the pattern singing of the teacher. But this process must be methodical, sensible, and effective. From the very first the teaching of singing should include *voice training*, and *voice exercises*. Children should be taught how to *distinguish* musical sounds, and how to *produce* them. The principal notes, 'strong tones,' of the scale should be sounded one at a time by the teacher. The attention of the class must be directed to the sound itself, and to the way in which the teacher's mouth is opened so as to produce it. They should then be encouraged to make a similar sound, it may be to the syllable *la*, or, if preferred, to the Sol Fa syllables. I should deem it, however, to be better to keep for a time to the one syllable *la*. The sound, its duration, softness or loudness, repetition at intervals, should all be taught step by step till some degree of precision in these several particulars is secured.

And these exercises in sound-production may even be associated with the use of symbols. It matters little at this stage whether the symbols employed be those of the Staff Notation, or the Tonic Sol Fa Modulator, or the fingers of the left hand used with the intervening spaces to represent the lines and spaces of the ordinary staff scale. The great point is, as an introduction to the teaching of singing by note, to accustom the children to associate the sound with the symbol, so that the tonic, or key-note, being given, the pointing to the finger of the hand, or to the line or letter on the modulator, or to the open note, say semibreve, or the line or space of the scale, shall be at once followed by their giving the sounds, singly, or in due succession.

In teaching a new song and tune the teacher should first sing a verse of it herself, the children looking and listening; when their interest and attention are thus caught, it is well as a rule to teach the tune alone, the teacher taking a phrase or two of it to the syllable *la* only. She should then cause the little ones to imitate her *by themselves*. In this stage of the process the teacher should not sing with the children, they are better trained to accuracy and self reliance by being required to sing alone. When the first phrase or two is fairly mastered, proceed to the next, in the same way, continually revising and adding the part last learnt to the previous parts till the whole tune is known. The next step will be to go through the tune with the words, in a similar manner. Clear and distinct utterance of the words, soft and sweet singing and correct time should be aimed at from the first efforts of the children, and may be secured in reasonable degree, even with the youngest. 'Action Songs' are popular and highly appropriate with Infant Classes. Care should be taken to find such action and gesture as is suitable to the sense of the words; it should be natural, easy, and spirited in its application, and should be thoroughly taught with the words before using it in the singing.

Physical Exercise, or *Drill*, as it is now often called, must not only be frequently interspersed among other lessons, as an agreeable variety and relief, but must have its own special lessons. Some reasons for this, and some considerations regarding it, have been set forth in an early chapter of this series, and it has been incidentally referred to in connection with the treatment of 'Action Songs.'

There should be short, simple, natural exercises of various sorts. The children should be taught how to stand, to sit, to rise in concert, either at the teacher's word, or the motion of her hand, or other definite signal. Some such series of simple movements as are systematized in the easier exercises of what is known as 'Swedish Drill' should be followed. The lifting of the arms and hands right and left alternately and together, the extension of the arms forward or upward till both hands meet, the straightening of the body, so as to stand erect, the bending it in various directions, so as to exercise duly in turn all the muscles, the turning upon the heels, the marching in line and column, when done discreetly and shared throughout by the sympathetic action of the teacher, are delighted in by the little ones, and are an admirable means of training both of health and of discipline.

Where there is a playground suitable games should be devised and shared in heartily by the teacher. Indeed the children should never be left, either there or in the schoolroom, without the teacher's presence. The playground is an excellent field, too, for the exercise of most effective moral discipline. The children are free from the restraints of the schoolroom, and are likely there to display freely their natural tendencies and dispositions for good or evil. This makes it a valuable occasion for the watchful care of the observant teacher. Wrong doing can be checked, right doing can be fostered, and the process of practical moral training enforced under circumstances most favourable for its exercise.

General Hints.—Closely connected with the health and comfort and well being of the children are other matters which will not escape the notice of a thoughtful teacher. Their personal cleanliness and personal habits, the disposal of caps and outer clothing, so that if wet it may be dried before being worn again, the watchfulness necessary in regard to symptoms of illness, especially of infectious diseases, attention to the little ailments and accidents almost inseparable from the school life of children, and other circumstances expected and unforeseen, make great and constant demand upon the patience, tact, good sense, and general resources and skill of the Infants' Teacher. And the daily exercise of these precious qualities brings a rich reward to her who lovingly expends them, as she observes the fruit of her efforts in the gradual unfolding and development of intellect and of life in her young charge. How truly, as Canon Norris once observed in an address to teachers, the value of a school depends 'on the life that is lived in it,' on 'the heart and love and healthy moral influence at work' there.

I have again and again in the course of these chapters laid stress on the necessity of adapting all processes of instruction and discipline to the requirements of a child's nature. No teacher deals rightly with a child who does violence to that nature. Training and guiding, and controlling, it truly needs, but careful observation of its methods of acting, and due regard to what it shows us, are the true indications to the path of success in dealing with it. I have already strengthened points which I have endeavoured to set forth, by quotations from Dr. Fitch's 'Lectures on Teaching.' There is in his chapter on School Discipline a paragraph bearing so admirably on the matter last referred to, that I will emphasize it also in a similar manner.

'In governing it is of the last importance that we should well consider the nature of the being whom we want to control, and not demand of him an im-

possible standard of virtue. A little child has not your seriousness nor your sense of duty, nor your capacity for sitting still. He would be a very curious, almost an unpleasant phenomenon, if he had. On the contrary nature makes him physically restless, very curious, mobile, and inquisitive, and exceedingly deficient in reverence. And these qualities should be taken for granted and allowed for, not set down as faults. Provision should be made for giving lawful vent to his personal activity, and if such provision be not made, and he is called on to maintain a confined posture for an unreasonable time, his restlessness and disobedience are his teacher's fault not his. Let us take for granted that in every fault of a child there is an element of good, "would men observingly distil it out," that every act of mischief he is guilty of is only an example of perfectly healthy and legitimate activity, accidentally misdirected, and above all let us take care not to measure his fault by the inconvenience which it causes us, but rather by considering the motives and the causes of it. Some of the little wrong acts of a child which bring the most annoyance to a teacher and try his temper most are precisely those which from the point of view of a moralist are least blameworthy—talking at unreasonable times, destructiveness, untidiness, noise. These things have to be checked of course. But do not let us confuse the conscience of a child by exaggerating their seriousness or by treating offences against school rules as if they were breaches of the moral order of the universe. Consider what are the natural instincts of a child, and how unformed his moral standard is, and you will see that relatively to him offences of this kind are not crimes, though relatively to you and to the school they may be serious annoyances.'

(The end.)

—o—

Jeanne d'Arc, by Lamartine.

TRANSLATED BY A. M. BOWER,

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JEANNE D'ARC.	JOAN OF ARC.
VI.	
C'était en 1409.	It was in 1409.
La France se décomposait	France was being dis-
	integrated
avant d'avoir été achevée.	before being constituted a kingdom.
Cette grande monarchie,	This great monarchy
qui n'était presque plus	which had become little more
qu'une confuse fédération	than a confused federation
de vassaux indépendants	of independent vassals
et souvent rivaux de la couronne,	and frequently rivals of the crown
était tombée en lambeaux et en anarchie.	had fallen into pieces and into anarchy.
En perdant son unité,	While losing its unity,
elle allait perdre son indépendance.	it was going to lose its independence.
Le ciel l'avait frappée de deux fléaux :	Heaven had smitten it with two scourges :
une reine perverse et un roi insensé,	a perverse (obstinate) queen and a mad king,
un interrègne et une régence.	an interregnum and a regency.
Dans une monarchie, les interrègnes	In a monarchy, interregnums
sont les évanouissements de l'autorité,	are the eclipses of authority,
les régences sont	regencies are
les gouvernements de la faiblesse.	governments of weakness.
Une seule de ces conditions	A single one of these conditions
suffit pour perdre une nation.	is sufficient to destroy a nation.
Tout gouvernement est préférable	Any government is preferable
à ces gouvernements sans possesseurs	to these governments without governors
et disputés par l'intrigue ou	and contested by intrigues or
par les armes entre des partis ambitieux.	by arms among ambitious factions.
Charles VI. était roi de nom.	Charles VI. was king in name.
Frappé de démence par la terreur	Struck with madness by the fright
qu'il avait éprouvée	which he had received
en échappant avec peine à la mort	while escaping with difficulty from death
dans une fête	at a feast
où ses compagnons de plaisir et lui	in which his companions in pleasure and himself
s'étaient enduits d'étoupe et de résine	had covered themselves with tow and with resin
pour imiter les brutes,	in order to imitate wild beasts,
et où quatre de ses courtisans	and in which four of his courtiers
avaient été consumés sous ses yeux,	had been burnt to death under his eyes,
il languissait dans un idiotisme	he lingered in a state of idiotcy
interrompu par des fureurs	broken by fits of fury
ou par des abattements	or by prostrations
qui le rendaient semblable à un enfant.	which reduced him to the state of a child.
Il avait épousé Isabeau de Bavière.	He had married Isabeau of Bavaria.
Cette reine, douée par la nature	This queen, endowed by nature
de la beauté des Poppée et des Théodora,	with the beauty of Poppaea and Theodora,
ces courtisanes élevées au trône par le vice,	these courtesans raised to the throne by vice,
en avait aussi les légèretés,	inherited also their levity,
les perversités et les ambitions.	their perversity and ambition.
A peine cette jeune princesse	Scarcely had this young princess
était-elle montée sur le trône,	mounted the throne,
qu'elle avait pressenti	than she had foreseen
dans son mari la puérilité d'esprit	in her husband the weakness of mind
qui devait bientôt dégénérer en démence.	which was soon to degenerate into madness.
Livrée, par les mœurs corrompues	Given up by the corrupt manners
de cette époque et de cette cour,	of this period and of this court,
au tourbillon des plaisirs les plus emportés,	to the vortex of the most unrestrained pleasures,
elle avait ressenti	she had felt
une passion coupable et politique	a culpable and politic passion
pour le jeune duc d'Orléans frère du roi.	for the young Duke of Orleans, brother of the king.
Ce prince, plus fait	This prince, more fitted (*made*)

par son courage pour le trône,
by his courage for the throne,

plus fait par sa grâce
more suited by his grace

pour séduire le cœur d'une femme,
to win the heart of a woman,

avait partagé par inclination
had shared from inclination

et par ambition cette ardeur.
and ambition this passion.

Une orgie nocturne,
A night revelry,

à la suite d'une mascarade,
following a masquerade,

avait préludé au crime.
had been the forerunner of this crime.

Depuis cette époque fatale,
Since this fatal moment,

le duc d'Orléans et la reine,
the Duke of Orleans and the queen,

unis de passion,
united in passion,

de crime et d'intérêt, régnaient.
crime and interests, reigned.

Les grands vassaux, les oncles du roi,
The great vassals, the uncles of the king,

le duc de Bourgogne, le duc d'Anjou,
the Duke of Burgundy, the Duke of Anjou,

le duc de Bretagne, jaloux de ce règne
the Duke of Brittany, jealous of this reign

qui leur enlevait l'exploitation du royaume,
which took away from them the government of the kingdom,

avaient entraîné dans leur cause
had led away in their cause

le fils encore enfant du roi.
the infant son of the king.

Dans ces jours de férocité,
During these terrible days,

qui rappelaient l'ancienne Rome
which recalled (the memory of) ancient Rome

par les meurtres
by the assassinations

et la nouvelle Italie par les conjurations,
and modern Italy by the conspiracies,

toutes les intrigues se dénouaient
all intrigues ended

par des assassinats
in assassination.

Le duc d'Orléans, appelé
The Duke of Orleans, called out

une nuit sous un faux prétexte,
one night under a false pretence,

et sortant du palais de la reine,
and (on) leaving the palace of the queen,

est renversé de son cheval
was unhorsed

et frappé de treize coups de poignard
and stabbed with thirteen blows of the dagger

par vingt hommes inconnus,
by twenty unknown men,

qui laissent son corps sanglant dans la rue,
who left his bleeding corpse in the street,

à la porte de son hôtel.
at the door of his hotel.

La rumeur publique accuse
The public rumour accused

le duc de Bourgogne du crime,
the Duke of Burgundy of the crime,

le jeune Dauphin d'acquiescement,
the young Dauphin of acquiescing therein,

ses partisans de complicité.
his partisans of complicity in it.

La reine, qui perd à la fois
The queen, who lost at once

son amour et sa force,
her lover and her support,

jure de laver ses larmes
swore to wash her tears

dans le sang du meurtrier.
in the blood of the assassin.

Elle se ligue avec le connétable d'Armagnac,
She allied herself with the constable of Armagnac,

beau-père du duc d'Orléans assassiné,
father-in-law of the murdered Duke of Orleans,

contre le duc de Bourgogne.
against the Duke of Burgundy.

Les d'Armagnacs, famille sanguinaire,
The D'Armagnacs, a blood-thirsty family,

proscrivent, massacrent, sont proscrits
proscribe, massacre, and are proscribed

et massacrés tour à tour dans Paris.
and massacred in their turn in Paris.

Servant et dominant à la fois la reine,
Serving and at the same time domineering over the queen,

leur instrument et leur victime,
their tool and their victim,

ils s'alarment de l'ascendant d'un nouveau favori, le jeune Boisbourdon.
they become alarmed at the ascendancy of a new favourite, the young Boisbourdon.

Ils osent l'immoler aux pieds de la reine,
They dare to murder him at the feet of the queen,

pour régner seuls en son nom.
so as to govern alone in her name.

Désespérée de la mort, furieuse du crime,
In despair at his death, enraged at the crime,

humiliée du joug, Isabeau sacrifie
humiliated at the yoke, Isabeau sacrifices

ses ressentiments passés à sa haine présente.
her past resentment to her present hatred.

Elle conspire avec le duc de Bourgogne
She plots with the Duke of Burgundy

la perte et la mort des Armagnacs,
the destruction and death of the Armagnacs,

et lui vend à la fois
and barters away to him

leur sang et son cœur,
at once their blood and her heart,

en échange de la vengeance
in exchange for the vengeance

qu'elle attend de lui.
which she expects from him.

Le duc de Bourgogne rentre
The Duke of Burgundy enters,

à la faveur de cette trame dans Paris,
thanks to this plot, into Paris,

immole les Armagnacs,
butchers the Armagnacs,

satisfait et assujettit la reine,
satisfies and overrules the queen,

prend la tutelle du roi,
assumes the guardianship of the king,

combat dans les provinces
combats in the provinces

contre les restes du parti contraire
against the remains of the opposite party

unis aux Anglais.
united with the English.

Les Français, ainsi déchirés en factions,
The French, thus torn by factions,

succombent à la bataille d'Azincourt
are beaten at the battle of Agincourt

qui livre la patrie au roi d'Angleterre
which gave up the country to the king of England

sur les cadavres de la noblesse française.
over the corpses of the French nobility.

Sept princes de la maison royale
Seven princes of the Royal house

sont ensevelis sur ce champ de bataille.
were buried on the field of battle.

Le fils aîné du roi meurt de douleur ;
The eldest son of the king died of grief ;

son frère, du poison versé dans ses veines
his brother, of poison poured into his veins

par les ennemis des Bourguignons.
by the enemies of the Burgundians.

Le troisième fils du roi, alors Dauphin,
The third son of the king, then the Dauphin,

devenu plus tard Charles VII,
(who) became later Charles VII.,

grandit dans cette alternative
grew up in such changes,

de mollesse et de proscriptions,
of effeminacy and proscription,

qui rappelle Rome par le sang
as to remind one of Rome for the blood (spilt)

et les Gaules par la légèreté.
and the two Gauls for the levity (displayed).

Il s'essaie à gouverner
He tries to govern

avec les Armagnacs.
with the Armagnacs.

Il affecte la lassitude de la guerre
He affects a weariness of the war

et la soif de la paix.
and a thirst for peace.

Il décide avec peine
He persuaded with difficulty

le duc de Bourgogne à une entrevue,
the Duke of Burgundy to an interview,

prélude d'une réconciliation générale
the prelude to a general reconciliation

des princes et des partis,	of the princes and parties,
sur le pont de Montereau.	on the bridge of Montereau.
Le duc de Bourgogne,	The Duke of Burgundy,
poursuivi par l'ombre de sa victime,	pursued by the shade of his victim,
le duc d'Orléans, hésite et craint	the Duke of Orleans, hesitates and fears
un piège dans son triomphe.	a snare in his triumph.
On l'entraîne, il entre	They drag him reluctantly there, he enters
dans le pavillon de la conférence,	into the pavilion of the conference,
il y tombe à l'instant	he falls instantly there
sous la hache de Tanneguy du Châtel.	under the axe of Tanneguy du Chatel.

(To be continued.)

—o—

Our Certificate Class.

BY DR. GEORGE BEACH.

Head Master of Christ Church School, Macclesfield.

The last (March) number of the PRACTICAL TEACHER was of peculiar service in the prosecution of our design. We would call our readers' attention to the articles on I. Technical Instruction, II. Pestalozzi, III. Size and Shape of the Earth (Notes of Lessons), IV. Model Answers to Certificate Questions (1887), and V. Parallel Translation of Jeanne d'Arc. In our list of books we omitted to mention the Clarendon Press Comus, McLeod's Constitutional History, Elsom's Stocks (published by Elsom, Hull). We would also more particularly recommend Davies' three Historical Manuals, 1689—1760, 1760—1815, and 1760—1815 (Literature).

Our routines for April specify the actual amount of work to be done during that month. The information given and the analysis of School Management inserted, have been compiled after a careful study of eighteen years' questions. This Analysis includes every question (about 250), and nothing besides, given since 1869, and is thus exhaustive although not superfluous. To students in training (who do not require our routines) it should be very serviceable.

There is a very natural desire for information respecting the marks given for and the relative value of each subject, etc. It is significant that the Department has shown upon these points an increasing reticence. In the Syllabus for 1874 were given, A, the number of marks requisite for the various divisions of Certificates; B, the different Standards of proficiency required from acting-teachers and students in training; C, the number of marks given for each subject; D, the failing subjects. In the 1875 Syllabus the information under heads 'C' and 'D' was withheld. Next, in the 1878 Syllabus only the failing subjects were specified; and since 1883 no enlightenment on the above four points has been published.

LATEST INFORMATION UNDER HEADS 'A' AND 'B'

		By Acting-Teachers	By Students in Training
Percentage of marks requisite to obtain a Certificate of	1st Division	63	64
	2nd ,,	49	52
	3rd ,,	33	36
	4th ,,	27	30

LATEST INFORMATION UNDER HEAD 'C'

Reading	100 marks	Geography	62 marks
Penmanship	75 ,,	History	63 ,,
School Management	75 ,,	Political Economy	62 ,,
Teaching	125 ,,	Music	88 ,,
Composition	50 ,,	Drawing	62 ,,
Mathematics	225 ,,	Languages	125 ,,
Grammar	63 ,,	Sewing and Cutting out	100 ,,
Domestic Economy	63 ,,		

(There is reason to believe that the marks for the separate subjects are more nearly equal now than they were, especially the alternative subjects.)

Latest information under head 'D' shows that Reading, Penmanship, Arithmetic, Composition, Spelling, Parsing, and School Management were the failing subjects; and from internal evidence and a collation of the current opinion of specialists, we believe them still to be of paramount importance.

Therefore commencing first with SCHOOL MANAGEMENT, special hints will be from month to month given with respect to these subjects.

SCHOOL MANAGEMENT.—Doubtless a teacher before assuming responsibility should be saturated with Mental and Moral Philosophy, and certainly the Department are slowly inclining to this view. Yet we shall not be guided by our own utopian ideas of what should be but shall proceed in accordance with the system in vogue, having for our chief aim the assisting the student to 'PASS HIS EXAM.'

On analysing, it will be found that at least half the questions can be answered without special study by an experienced 'Practical Teacher,' and of this portion, the questions upon 'REGISTRATION AND RETURNS' are the most easily 'spotted.

If our readers understand—what registers are required—who should keep them—who is responsible for them—what particulars they contain—why these particulars are necessary—why no erasures are allowed—how the registers can be verified—how errors may be rectified, or incomplete attendances cancelled—the exceptions caused by Religious Examinations or elections—the way to mark an attend. register—when a scholar has *bona fide* left—what qualifies a scholar for entrance on Exam. schedule—how to draw up specimen registers—how to fill up Form IX.—how to keep a log book; then they will be impregnable under the above 'head.'

ORGANISATION AND MANAGEMENT.—The candidates must also know—what is meant by organisation—the principles of the various systems of classification—when to examine—how to organise a school, or draw up a routine, with the minimum staff, with the maximum curriculum, so as to provide the P. T's with practical training, to diffuse equally the Head-Master's influence, and to suit the locality.

PROCESSES OF REASONING, HABITS AND CHARACTER, MORAL DISCIPLINE.—The chief points here to attend to are—the best books with which to commence and continue this study—what mental powers are exercised by particular subjects—the laws and provinces of memory, attention, association of ideas, the inventive faculty, and imagination—the various methods of reasoning by induction (synthesis), deduction (analysis), inference and analogy—the various forms of fallacy—the terms syllogism, hypothesis, demonstration, converse proposition, sense, sensation, sensibility, sensitiveness, perception, conception, intension, extension, convertible terms, reductio ad absurdum, reductio ad exhaustum—the meanings of habit—the meanings of character—the area of the teacher's influence—how to inculcate moral, prudential, regular, and healthy habits, as truthfulness, thrift, punctuality and cleanliness—the theory of punishments as to kind, amount and time of administration—how to eradicate particular vices—and the advantages and dangers of prizes, competition and emulation.

ANSWERS TO CORRESPONDENTS.

We shall be pleased to reply briefly, and through this column, to any seeking information or advice.

PRIVATE STUDENT.—Yes. Get a tutor by all means, but we cannot undertake to recommend any particular one. Amateur 'coaches' will however save themselves much mental labour by using our Routines.

J. W.—We hope to assist 'collegians' somewhat, as well as acting-teachers. See our second paragraph of this month's paper.

ROUTINE FOR APRIL. (MALES.)

DAY	FIRST WEEK			SECOND WEEK			THIRD WEEK			FOURTH WEEK		
MONDAY	Articles 81 to 86 of Code. Articles 1 to 7 of Circular No. 217 (page 91 of Heller's Code). First half of p. 128 (Heller's Code)	First thirteen Propositions of Euclid, Book I.	Paraphrase Lines 32—56 of Cæsar, Act I. Scene I.	Deductions, 40, 45, 52, 58, 60, 64, 69, 74, 82, 83, of Egan, Part I.	Paraphrase first seventeen lines of Comus	Physical Features of England	Write out, for future use, the plot of Comus	Physical Map of England	Third and fourth chapters of McCarthy, *i.e.*, to close of A.D. 1842	Write out a list of Good Habits with their opposing Bad Habits	Deductions, 313, 315, 317, 321, 327, 329, 334, 341, 343, 346, of Egan Part I.	Study the Syntax of Nouns
TUESDAY	Possessions in Europe, including Cyprus	Square Root	Outlines of English History to end of Stephen	Cube Root of Arithmetic	First two chapters of McCarthy, or from 1837 to the 'Bedchamber Question'	Notes of a Reading Lesson to Standard I.	Study the Syntax of Nouns	Revise Algebra	Feudal System and Constitutions of Clarendon	Euclid, all Book II.	Notes and Text of Comus, to line 330	Infectious Disease, Wounds, and Cutaneous Disorders. (Carpenter. pp. 163—202)
WEDNESDAY	Involution and Evolution of Algebra	To end of page 20 of Jevon's Logic Primer	Deductions, 13, 14, 16, 19, 20, 23, 25, 26, 31, 36, of Egan, Part I.	Surds (Algebra)	First forty-one Propositions of Euclid, Book I.	Write a short life of Shakespere for future use	Deductions, 135, 137, 148, 151, 156, 163, 165, 168, 175, 179, of Egan, Book I.	Paraphrase (page 2 of Essay on Milton) 'By the general suffrage..... which defy imitation'	Causes which affect Climate. Findlater, Part I., pp. 116—124	Rivers of Hindostan with Towns thereon, etc.	Mensuration of Right-Lined Surfaces	Revise 'McCarthy,' *i.e.*, English History from 1837 to 'Irish Famine'
THURSDAY	Write 30 lines of Composition upon 'It is meet that noble minds keep ever with their likes'	Write a 'Text Hand' copy of the word 'Communion' and a copy of 'Small Hand'	First twenty-six Propositions of Euclid, Book I.	Cyprus, and Mountains of Hindostan	Stocks	Tables of Norman and Plantagenet Dynasties	Interest	Fifth, sixth, and seventh chapters of McCarthy, *i.e.*, to the 'Irish Famine'	Ratios (Algebra)	Notes and Text of Cæsar, to 85th line of Act II. Scene I.	Cube Root of both Arithmetic and Algebra	Notes of a Writing Lesson to Standard VII.
FRIDAY	Notes of Cæsar to page 124, or to 85th line of Act II. Scene I.	Shape and size of the Earth (page 9 of March Number)	Mensuration of Squares, Rectangles, and surfaces of Rectilinear Solids	Revise Algebra	Canon Warburton's Article on Pestalozzi in our March issue	Deductions, 92, 101, 105, 107, 110, 113, 115, 118, 121, 128, of Egan, Part I.	Flora and fauna of the Torrid Zone	First ten Propositions of Euclid, Book II.	Write thirty lines of Composition comparing Shakespeare and Milton	Deductions, 352, 359, 363, 364, 366, 369, 371, 374, 378, 388, of Egan, Part I.	Read carefully through half the Essay on Addison	Physical Features of Ireland
SATURDAY	Important Dates to end of Stephen	Notes of Cæsar up to page 124, or to 85th line of Act II., Scene I.	G.C.M. (H.C.F.), and L.C.M. of Algebra	Site of School. To end of page 27 of Carpenter's Hygiene	Notes of Comus to line 169	Learn what Registers are necessary and what information the Admission Register must contain	Euclid, Book I.	Mensuration of Parallelograms and Triangles	Physical Features of Scotland	Discount	Outlines of English History to end of Richard I.	G.C.M. and L.C.M. of Algebra	Discount	Important Dates to end of Richard I.	Revise Algebra	Write, *for future use*, a Summary of Canon Warburton's Article on Pestalozzi

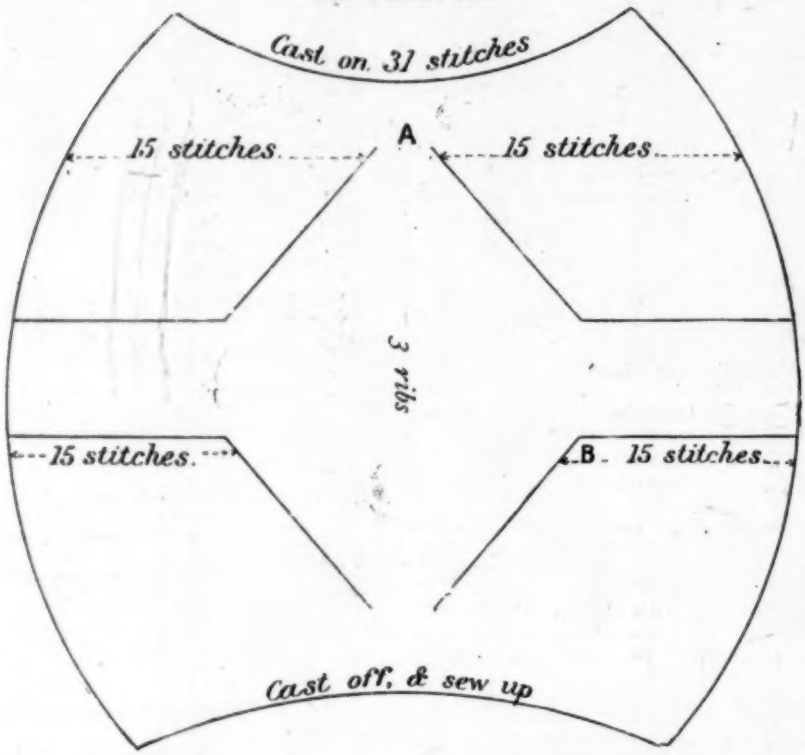
ROUTINE FOR APRIL. (FEMALES.)

DAY	FIRST WEEK				SECOND WEEK				THIRD WEEK				FOURTH WEEK			
MONDAY	Articles 81 to 86 of Code. Articles 1 to 7 of Circular No. 227 (page 91 Heller's Code) First half of page 128 Heller's Code.	Analyse, and Parse difficult words of, Lines 306—318, of Cæsar Act I. Scene II.	Physical Features of England		Marlborough's Campaigns	Interest	Political Geography of Hindostan		The different diets required in the different disorders	To end of page 20 of Jevon's Logic Primer	Map of British North America		Stocks	Geography of Canada	Write a short life of Shakespere for future use	
TUESDAY	Union of England and Scotland. The 'Place Act.' Trial of Dr. Sacheverell	Vulgar Fractions	Paraphrase Lines 32—56 Cæsar Act I., Scene I.		Physical Map of England	How should an Artizan's wage of 30/- be spent in a family of five?	How should a woman's nightdress be made?		Site of School. To end of page 27 of Carpenter's Hygiene	Discount	Outlines of Geography of British North America		Outlines of Anne's reign	The average waste in, and average food required by, a healthy adult	Cut out on Sectional Paper and tack together the sleeve half of 'a muslin pinafore'	
WEDNESDAY	The essential constituents of a true food	Notes of a Reading Lesson to Standard I.	Learn the measurements of 'A woman's nightdress'		Queen Anne's Bounty. Inventions and Improvements	Insurance (Arithmetic)	Syntax of Nouns		Geography of Scotland	The ordinary beverages	Canon Warburton's Article on Pestalozzi in our March number		Notes of Cæsar as before	How should a muslin pinafore be made?	Learn what Registers are necessary and what information the Admission Register must contain	
THURSDAY	Map of Hindostan	Practise the different stitches on a piece of linen 9 inches square	Decimal Fractions		Infectious Diseases, Wounds and Cutaneous Disorders (Carpenter 163—202)	Advantages of a mixed diet of flesh and vegetables. Disorders from improper Diets	Lives and works of Wycherley, Congreve, Cibber, Young, Ramsey, Tickell		Analyse, and Parse difficult words of, Lines 66—78 of Cæsar Act II. Scene I.	Conquest of Canada and Life of Wolfe	Square Root		Geography of Ireland	How would you make Beef Tea, Gruel, and Barley Water?	Discount	
FRIDAY	Describe a house and its furniture which can be maintained for 30/- per week in a small town	Proportion	Amalgamation of the East India Companies. Treaty of Utrecht. Gibraltar.		Paraphrase Lines 31—47 of Act I. Scene II. Cæsar	Cut out on Sectional Paper and tack together the right half of 'a woman's nightdress'	Notes of a Writing Lesson to Standard VII.		How can a working-man best invest a few pounds annually?	Write 30 lines of Composition upon 'It is meet that noble minds keep ever with their likes'	Practise the different stitches on a piece of calico 9 inches square		Write out a list of Good Habits with their opposing Bad Habits	Select any peculiar expressions or familiar phrases from first half of Addison	Outline of George I. reign	
SATURDAY	Describe the chief characteristics of Macaulay's style of Essay writing	Riot Act. Septennial Act. Poor Law Act	Learn Physical Features of Hindostan	Write a 'Text Hand' copy of the word 'Communion' and twenty lines of 'Small Hand'	Stocks	Notes of Cæsar to page 124 or to 85th line of Act II. Scene I.	How should 'Food for Sick' differ from ordinary food?	Practise Stocking-web and a Print Patch	Insurance	Notes of Cæsar to page 124, *i.e.*, to line 85 of Act II. Scene I.	Learn the measurements and draw a diagram of 'a muslin pinafore'	Naval operations from 1700 to 1727	Syntax of Nouns	Remaining Geography of British North America	Square Root and Fourth Root	Draw up for future use a Summary of the article on Pestalozzi

Knitting Maps.

BY MRS. J. D. HARRIS.

LADY'S KNEE CAP.



2 Bone pins. No. 11 Chamber's bell gauge.

2 oz. Berlin fingering.

Knee caps are far more elastic and comfortable if they are ribbed, than when knitted plain.

2 rows plain, and 1 purl, make a good rib.

The increasings and decreasings for the knee gusset are always made on the right side. The reverse row is to be plain or purl according to the rib, except the gusset, which should be knitted plain.

Cast on 31 stitches.

Knit 3 ribs.

To increase for Gusset.

A. Knit 15. Raise a stitch. Knit 1. Raise 1. Knit 15.
In the reverse row it will be knit 3 in the gusset, and of course 2 more stitches in each succeeding row.
Repeat from A. (knitting the stitches between the 2 raised stitches) till you have 56 stitches in all on your pin.
Knit 3 ribs.

To decrease.

B. Knit 15. Knit 2 together. Knit to within 17 of the end. Knit 2 together. Knit 15.
Repeat from B. (on the right side) till you have reduced to 31 stitches.
Knit 3 more ribs, cast off, and sew up the seam.

Model Answers to Certificate Questions, Christmas, 1887.

Male Candidates.

FIRST YEAR.

Euclid.

(Two hours and a half allowed for this Paper.)

Candidates are not allowed to answer more than EIGHT questions.

Capital letters (*excluding A, B, C, D, E, F*), not numbers, must be used in the diagrams.

The only signs allowed are + and =.

The square on PQ may be written 'sq. on PQ,' and the rectangle contained by PQ, and RS, 'rect. PQ, RS;' other abbreviations, if employed, must not be ambiguous.

1. From a given point, to draw a straight line equal to a given straight line.

When the given point is neither in the given line nor in it produced, in what different ways may the straight line be drawn?

Proposition 2, Book I.

When the given point is neither in the line, nor in the line produced, the problem admits of *eight* different lines being drawn from the given point in different directions, every one of which is a solution of the problem.

(1) The given point may be joined with either extremity of the given line.

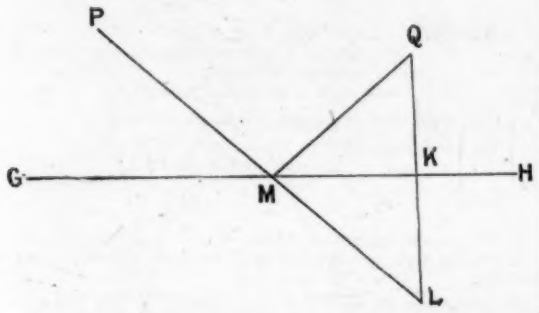
(2) The equilateral triangle may be described on either side of these two lines, giving four equilateral triangles.

(3) In each of these triangles the sides may be produced either through the vertex or through the base, thus giving eight variations of the figure.

2. If two straight lines cut one another, the vertical, or opposite angles shall be equal.

From two given points on the same side of a given line, draw two lines which shall meet in that line and make equal angles with it.

Proposition 15, Book I.



Let P, Q be the given points and GH the given line.

Construction.—Draw QK perpendicular to GH (I. 12), and produce QK to L (Post. 2), making KL = QK. (I. 3.)

Join PL cutting GH in M, and join QM. (Post. 1.)

Then PM, QM shall be the lines required.

Proof.—In the triangles QKM, LKM, side QK = side LK (Con.), side KM is common to the two triangles, and angle QKM = angle LKM (Ax. 11), therefore base QM = base LM (I. 4), and angle QMK = angle LMK.

But angle PMG = angle LMK (I. 15), therefore angle PMG = angle QMK. (Ax. 1.)

Wherefore the lines PM, QM make equal angles with the given line GH.

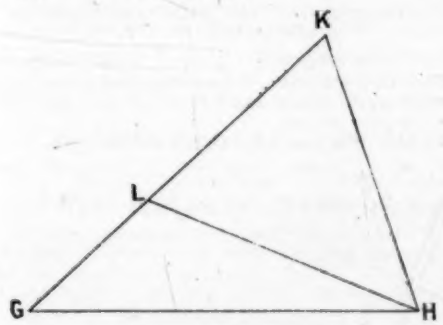
Q. E. F.

3. At a given point in a given straight line, to make a rectilineal angle equal to a given rectilineal angle.

Construct a triangle, having given one side, an adjacent angle, and the sum or difference of the other two sides.

Proposition 23, Book I.

(*a*) Sum of the other two sides.



Let GH be the given side, HGK the given angle, and GK the sum of the other two sides.

Construction.—Join KH. (Post. 1.)

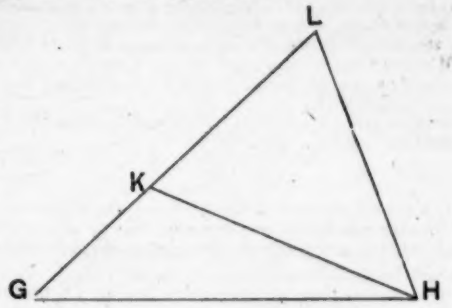
At the point H make the angle KHL = angle HKL. (I. 23.)

Then GLH shall be the triangle required.

Proof.—Because angle LHK = angle LKH (Con.), therefore LH = LK (I. 6); wherefore sum of GL and LH = GK, therefore GLH is the required triangle.

Q. E. F.

(*b*) Difference of the other two sides.



Let GH be the given side, HGK the given angle, and GK the difference of the other two sides.

Construction.—Join KH. (Post. 1.)

Produce GK to L (Post. 2), and at the point H make the angle KHL = angle HKL. (I. 23.)

Then GLH shall be the triangle required.

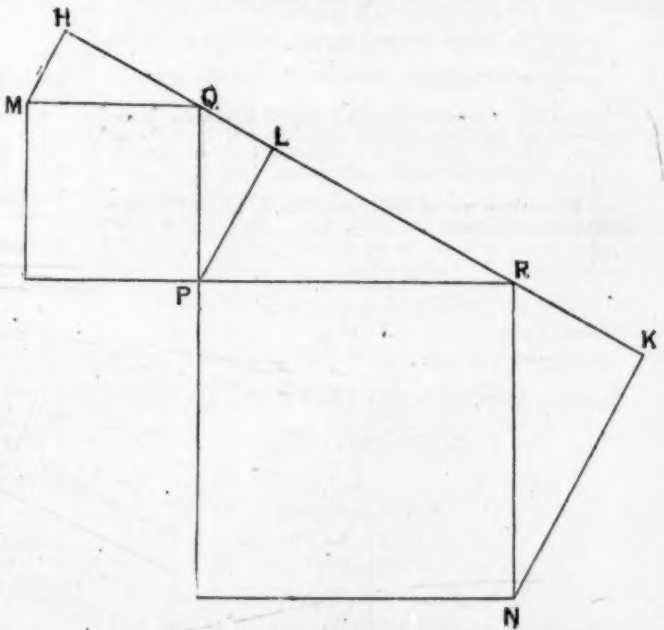
Proof.—Because angle LHK = angle LKH (Con.), therefore LH = LK (I. 6); wherefore difference between GL and LH = GK, therefore GLH is the required triangle.

Q.E.F.

4. If two triangles have two angles of the one equal to two angles of the other, each to each, and one side equal to one side, namely, sides which are opposite to equal angles in each, then shall the other sides be equal, each to each, and also the third angle of the one equal to the third angle of the other.

PM, PN are squares on the sides of the right-angled triangle QPR, and MH, NK are perpendiculars on the hypotenuse QR produced. Prove that QR and the triangle PQR are respectively equal to the sum of MH, NK, and of the triangles QMH, RNK.

Second part of Proposition 26, Book I.



Construction.—Draw PL perpendicular to QR. (I. 12.)

Proof.—Angle HQM = angle QRP (I. 29); now, angles LPR, PRL = a right angle (I. 32), and, angles LPR, LPQ = a right angle (Hyp.), therefore angles LPR, LPQ = angles LPR, PRL (Ax. 1), wherefore angle LPQ = angle PRL. (Ax. 3.)

In the triangles PQL, QMH, angle PLQ = angle QHM (Ax. 11), angle LPQ = angle HQM (Ax. 1), and side PQ = side QM, being sides of a square, therefore QL = MH (I. 26), and LP = HQ, therefore triangle PQL = triangle QMH. (I. 4.)

Similarly it can be proved that RL = NK, and triangle PRL = triangle RNK.

Wherefore QR = MH + NK, and triangle PQR = triangles QMH, RNK. (Ax. 2.)

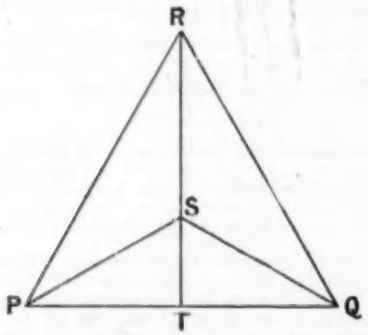
Q. E. D.

5. If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles; and the three interior angles of every triangle are equal to two right angles.

If there be an isosceles and an equilateral triangle upon the same base, and so that the inner vertex is equally distant from the other vertex, and from the extremities of the base, then, according as that of the former is the inner or outer vertex, its base angle will be $\frac{1}{4}$ or $2\frac{1}{2}$ times the vertical.

Proposition 32, Book I.

(*a*) When the vertex of the isosceles triangle is within that of the equilateral triangle.



Let PQR be an equilateral triangle, and PQS an isosceles triangle having its vertex within that of the other.

Join RS, and produce it to meet PQ in T. (Posts. 1 and 2.)

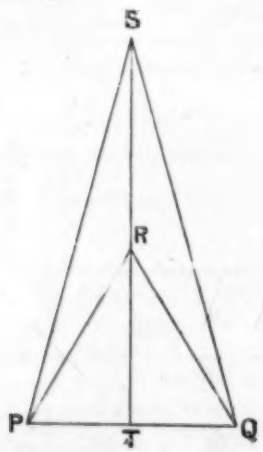
Proof.—RST bisects the angles at R and S and is at right angles to PQ.

Similarly, as SP, SQ, SR are equal, PS and QS bisect the angles at P and Q.

Angle PST = angles SPR, PRS (I. 32), = angle of equilateral triangle; and angle SPT = $\frac{1}{2}$ of angle of equilateral triangle, therefore angle SPT = $\frac{1}{4}$ angle PST = $\frac{1}{4}$ angle PSQ.

Q. E. D.

(*b*) When the vertex of the isosceles triangle is without that of the equilateral triangle.



Let the vertex of the isosceles triangle PQS fall without that of the equilateral triangle PQR.

Join SR, and produce it to meet PQ in T. (Posts. 1 and 2.)

Proof.—As before SRT bisects the angles at S and R, and is at right angles to PQ.

Angle PRT = angles RPS, PSR, (I. 32.)
= twice angle RPS or PSR, (I. 5.)

Therefore angle RPS or PSR = $\frac{1}{2}$ of angle PRT
= $\frac{1}{4}$ of angle PRQ
= $\frac{1}{4}$ of angle of equilateral triangle

Angle SPT = angle TPR + angle RPS
= angle of equilateral triangle + $\frac{1}{4}$ angle of equilateral triangle
= $\frac{1}{4}$ angle of equilateral triangle,

And angle PST = $\frac{1}{4}$ angle of equilateral triangle,

Therefore angle SPT = 5 times angle PST
= $2\frac{1}{2}$ times angle PSQ.

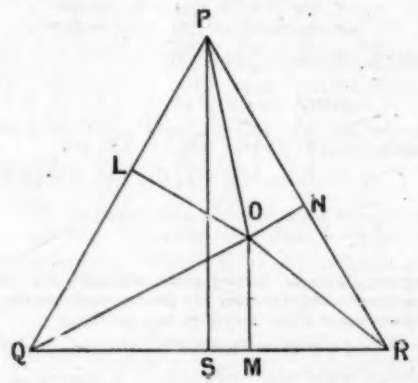
Q. E. D.

6. If a parallelogram and a triangle be on the same base and between the same parallels, the parallelogram is double of the triangle.

Hence deduce the area of a triangle when its base and altitude are given.

The three perpendiculars, let fall from any point within an equilateral triangle upon the sides, are together equal to the perpendicular from one of the angles upon the opposite side. Proposition 41, Book I.

Area of rectangle = base × altitude,
,, triangle = $\frac{1}{2}$ area of rectangle, (I. 41.)
= $\frac{1}{2}$ (base × altitude).



Let PQR be an equilateral triangle, and let perpendiculars be drawn from a point O to the sides, viz., OM, ON, OL.

Draw PS perpendicular to QR.

Then OM + ON + OL = PS, or the perpendicular from one of the angles upon the opposite side.

Proof.—Area of triangle POQ = $\frac{1}{2}$ area of rectangle PQ, OL, (I. 41.)

Area of triangle QOR = $\frac{1}{2}$ area of rectangle QR, OM,

Area of triangle POR = $\frac{1}{2}$ area of rectangle RP, ON;

But sum of triangles POQ, QOR, POR = triangle PQR,

And PQ, QR, RP are equal;

Therefore area of triangle PQR = $\frac{1}{2}$ area of rectangle QR, (OL + OM + ON);

But area of triangle PQR = $\frac{1}{2}$ area of rectangle QR, PS,

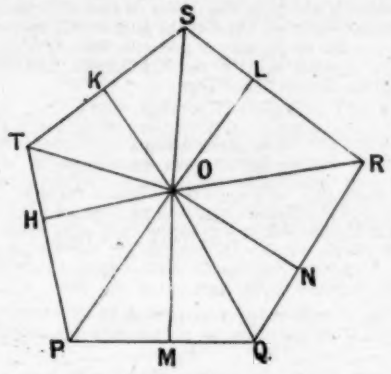
Wherefore OL + OM + ON = PS
= perpendicular from one of the angles upon the opposite side.

Q. E D.

7. If the square described on one of the sides of a triangle be equal to the squares described upon the other two sides of it; the angle contained by these two sides is a right angle.

From a point O perpendiculars OM, ON, OL, OK, OH are dropped on the sides PQ, QR, RS, ST, TP respectively, of the pentagon PQRST.

Show that the squares on MQ, NR, LS, KT, HP, are together equal to the squares on the alternate segments MP, HT, KS, LR, NQ. (Apply I. 47.)



Construction.—Join OP, OQ, OR, OS, OT. (Post 1.)

Proof.—Sq. on OQ = sq. on OM + sq. on MQ,
and also = sq. on ON + sq. on NQ;
Sq. on OR = sq. on ON + sq. on NR,
and also = sq. on OL + sq. on LR;
Sq. on OS = sq. on OL + sq. on LS,
and also = sq. on OK + sq. on KS;
Sq. on OT = sq. on OK + sq. on KT,
and also = sq. on OH + sq. on HT;
Sq. on OP = sq. on OH + sq. on HP,
and also = sq. on OM + sq. on MP;

Therefore, squares on OM, MQ, ON, NR, OL, LS, OK, KT, OH, HP
= squares on ON, NQ, OL, LR, OK, KS, OH, HT, OM, MP; (Ax. 2.)

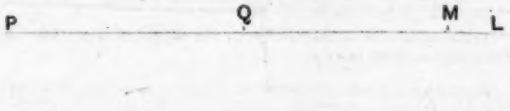
Wherefore, squares on MQ, NR, LS, KT, HP
= squares on MP, HT, KS, LR, NQ. (Ax. 3.)

Q. E. D.

8. If a straight line be divided into two equal parts, and also into two unequal parts, the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

State and prove the corollary. (Proposition 5, Book II.)

Corollary.—From this proposition it is manifest that the difference of the squares on two unequal lines is equal to the rectangle contained by their sum and difference.



Let PQ, RS be the two lines, of which PQ is the greater.

Then the difference between the squares on PQ, RS shall be equal to the rectangle contained by the sum and difference of PQ, RS.

Construction.—Produce PQ to L (Post 2), making QL equal to PQ (I. 3), and from QL cut off QM equal to RS.

Proof.—The rect. PM, ML together with the sq. on QM = sq. on QL. (II. 5.)

But PM = sum of PQ, QM
= sum of PQ, RS; (Con.)

And ML = difference of QL, QM
= difference of PQ, RS; (Con.)

Therefore the rectangle contained by the sum and difference of PQ, RS, together with the square on RS, is equal to the square PQ;

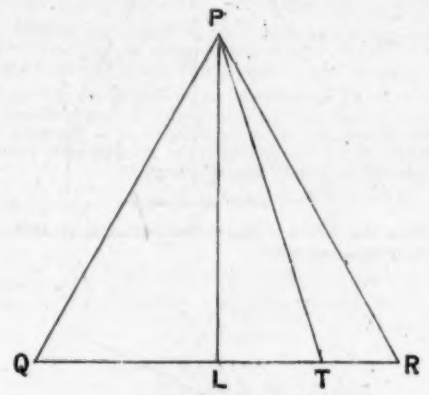
Wherefore the difference of the squares on PQ, RS is equal to the rectangle contained by their sum and difference. (Ax. 3.)

Q. E. D.

9. In every triangle, the square on the side subtending an acute angle is less than the squares on the sides containing that angle by twice the rectangle contained by either of these sides, and the straight line intercepted between the perpendicular let fall on it from the opposite angle and the acute angle.

T is a point in the side QR of an equilateral triangle PQR. Prove that the squares on QT, TR are together less than the square on PT by the rectangle contained by QT, TR.

Proposition 13, Book II.



Draw PL perpendicular to QR.

Proof.—Sq. on PT = sq. on PR + sq. on TR less twice rect. LR, TR
= sq. on QR + sq. on TR less rect. QR, TR
= sq. on QR + sq. on TR less (rect. QT, TR + sq. on TR) (II. 3.)
= sq. on QR less rect. QT, TR
= sq. on QT + sq. on TR + twice rect. QT, TR less rect. QT, TR (II. 4.)
= sq. on QT + sq. on TR + rect. QT, TR;

Therefore squares on QT, TR are together less than the square on PT by the rectangle contained by QT, TR.

Q. E. D.

10. Divide algebraically a given line a into two parts, so that the squares of the whole and one part are together double of the square of the other part.

From your answer, deduce the construction for the corresponding geometrical problem, remembering that if the side of an equilateral triangle is represented by $2a$ linear units, the perpendicular from any one of its angles upon the side opposite will be represented by $a\sqrt{3}$.

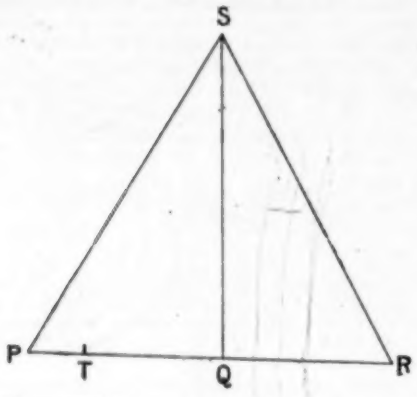
ALGEBRAICAL SOLUTION.

Let x = one part,
Then, $a - x$ = other part;

$$\therefore a^2 + x^2 = 2(a - x)^2 \quad \text{(Hyp.)}$$
$$= 2(a^2 - 2ax + x^2)$$
$$= 2a^2 - 4ax + 2x^2$$
$$2x^2 - x^2 - 4ax = a^2 - 2a^2$$
$$x^2 - 4ax = -a^2$$
$$x^2 - 4ax + (2a)^2 = 4a^2 - a^2$$
$$= 3a^2$$
$$x - 2a = \pm a\sqrt{3}$$
$$\therefore x = 2a \pm a\sqrt{3}.$$

Wherefore one part $= 2a - a\sqrt{3}$
or $a(2 - \sqrt{3})$,
and the other part $= a - (2a - a\sqrt{3})$
$= a - 2a + a\sqrt{3}$
$= a\sqrt{3} - a$
or $a(\sqrt{3} - 1)$.

GEOMETRICAL CONSTUCTION.



Let PQ represent a.

Produce PQ to R (Post. 2), making QR = PQ; (I. 3.)

Upon PR describe equilateral triangle PRS (I. 1), and join SQ (Post. 1).

Then PR = $2a$,

And SQ = $a\sqrt{3}$;

From RP cut off RT = SQ;

Then PT = PR − SQ

= $2a - a\sqrt{3}$

= first required part of the line.

Wherefore PQ is divided into two parts at the point T, so that the squares on PQ, PT are together double of the square on QT.

Q. E. F.

Male Candidates.

SECOND YEAR.

Euclid.

(*Three hours allowed for this Paper.*)

(Not more than EIGHT questions may be answered. Candidates are reminded that correct solutions of the deductions obtain high marks.)

N.B.—Capital letters (*excluding A, B, C, D, E, F*), not numbers, must be used in the diagrams.

The only signs allowed are + and =. The square on PQ may be written 'sq. on PQ,' and the rectangle contained by PQ, and RS, 'rect. PQ, RS.' Other abbreviations, if employed, must not be ambiguous.

1. To bisect a given rectilineal angle, that is, to divide it into two equal parts.

In the construction, why is the triangle described on the side *remote* from the apex of the given angle?

Proposition 9, Book I.

If the equilateral triangle were described on the *same* side, its vertex might coincide with the apex of the angle, and then the construction would fail. Or the vertex of the triangle might fall outside the angle, when the line joining the vertex and the angle would have to be produced in order to bisect the angle, and the proof would require modification. The restriction introduced insures that the vertex shall fall within the angle.

2. If a straight line fall on two parallel straight lines, it makes the alternate angles equal to one another, and the exterior angle equal to the interior and opposite angle on the same side; and also the two interior angles on the same side together equal to two right angles.

Enunciate the propositions of which this is the converse.

Proposition 29, Book I.

This is the converse of Propositions 27 and 28.

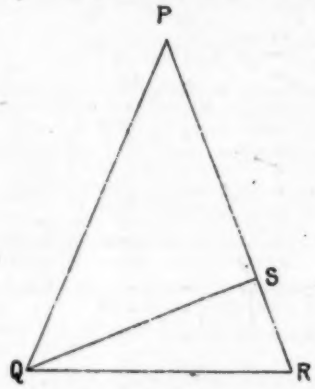
Prop. 27.—If a straight line falling on two other straight lines make the alternate angles equal to one another, the two straight lines shall be parallel to one another.

Prop. 28.—If a straight line falling on two other straight lines make the exterior angle equal to the interior and opposite angle on the same side of the line, or make the interior angles on the same side together equal to two right angles, the two straight lines shall be parallel to one another.

3. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by these parts.

If from one of the equal angles of an isosceles triangle a perpendicular be dropped on the opposite side, the square on that perpendicular is equal to the square on the line intercepted between it and the other equal angle, together with twice the rectangle contained by the segments of the side.

Proposition 4, Book II.



Let PQR be an isosceles triangle, and let QS be drawn perpendicular to PR from one of the equal angles.

Then the square on QS shall be equal to the square on SR, together with twice the rectangle PS, SR.

Proof.—Sq. on PQ = sq. on QS + sq. on PS, (I. 47.)

∴ Sq. on QS = sq. on PQ less sq. on PS (Ax. 3.)

= sq. on PS + sq. on SR + twice rect. PS, SR less sq. on PS (II. 4.)

= Sq. on SR + twice rect. PS, SR.

Q. E. D.

4. When is a straight line said to touch a circle?

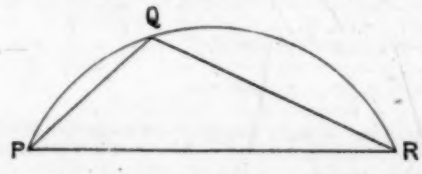
What is the distinction between the angle of a segment and the angle in a segment?

If any two points be taken in the circumference of a circle, the straight line which joins them shall fall within the circle,

A straight line is said to touch a circle when it meets the circle and being produced does not cut it.

The angle of a segment is that which is contained by the straight line which is the base of the segment and the arc.

An angle in a segment is the angle contained by two straight lines drawn from any point in the arc of the segment to the extremities of the straight line which is the base of the segment.



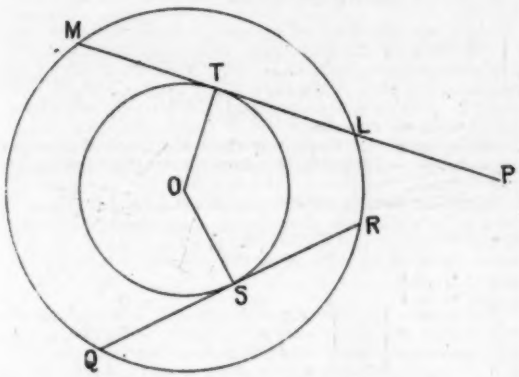
The angle formed by PR and the arc PQR is the angle of the segment, whereas the angle PQR is an angle in the segment,

Proposition 2, Book III.

5. To draw a straight line from a given point, either without or in the circumference, which shall touch a given circle.

Draw through a given point P without a given circle a straight line such that the part of it intercepted by the circle may be equal to a given chord of the circle.

Proposition 17, Book III.



Let P be the given point and QR the given chord.

Construction.—Find O the centre of the circle (III. 1), and draw OS perpendicular to QR (I. 11).

From the centre O at the distance OS describe a circle. (Post. 3.)

From P draw a tangent to this circle touching it at T (III. 17), and cutting the circle QRL at L and M.

Then PM shall be the line required.

Proof.—Because OT = OS,

And OT is perpendicular to ML (III. 18.)

„ OS „ „ SR (Con.)

Therefore ML = QR, (III. 14.)

Wherefore PM is the line required.

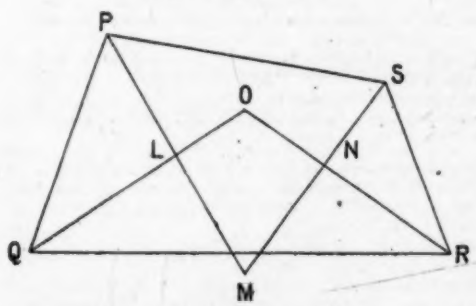
It is evident that the other tangent from P also fulfils the condition.

Q. E. F.

6. The opposite angles of any quadrilateral figure inscribed in a circle, are together equal to two right angles.

If through the angles of a quadrilateral, lines bisecting them be drawn, the points in which each line intersects the adjacent lines will lie on the circumference of a circle.

Proposition 22, Book III.



Let PQRS be a quadrilateral, and let its angles be bisected by the straight lines PM, QO, RO, SM, forming the quadrilateral LMNO.

Then the points L, M, N, O will lie on the circumference of a circle, that is, a circle can be described round the quadrilateral LMNO.

Proof.—Angle PLQ and half of angles at P and Q = Two right angles, (I. 32.)

And angle RNS and half of angles at R and S = Two right angles;

Therefore, angles PLQ, RNS, and half of angles at P, Q, R, S = Four right angles, (Ax. 2.)

And half of angles at P, Q, R, S = Two right angles (I. 32, Cor. 1.)

Wherefore, angles PLQ, RMS = Two right angles; (Ax. 3.)

But, angles OLM, OLN = Angles PLQ, RNS, (I. 15.)

Therefore, angles OLM, OLN are together equal to two right angles; (Ax. 1.)

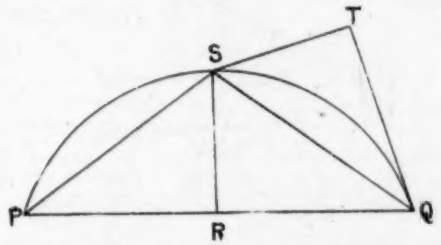
Wherefore a circle can be described round the quadrilateral LMNO. (Converse of III. 22.)

Q. E. D.

7. If a straight line touch a circle, and from the point of contact a straight line be drawn cutting the circle, the angles which this line makes with the line touching the circle shall be equal to the angles which are in the alternate segments of the circle.

Prove that the perpendicular drawn from the middle point of the arc of a circle upon the chord of the arc is equal to the perpendicular drawn from the same point upon the tangent at an extremity of the arc.

Proposition 32, Book III.



Let the chord PQ be bisected in R, and let RS be drawn at right angles to PQ, and ST perpendicular to the tangent at Q.

Then SR shall be equal to ST.

Join SP, SQ.

Proof.—The triangles SRP, SRQ are equal in every respect. (I. 4.)

Angle SQT = Angle SPQ, (III. 32.)

= Angle SQR, (Ax. 1.)

And angle STQ = Angle SRQ, (Ax. 11.)

And side SQ is common to the two triangles SRQ, STQ,

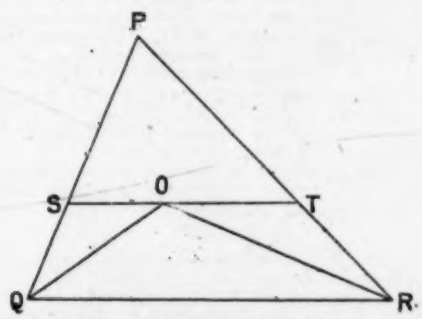
Therefore, SR = ST. (I. 26.)

Q. E. D.

8. To inscribe a circle in a given triangle.

If a new triangle be cut off by a line parallel to the base and passing through the centre of the inscribed circle, the perimeter of this triangle will be equal to the sum of the two sides of the first triangle.

Proposition 4, Book IV.



Let ST be drawn parallel to the base QR of the triangle PQR through the centre O of the inscribed circle.

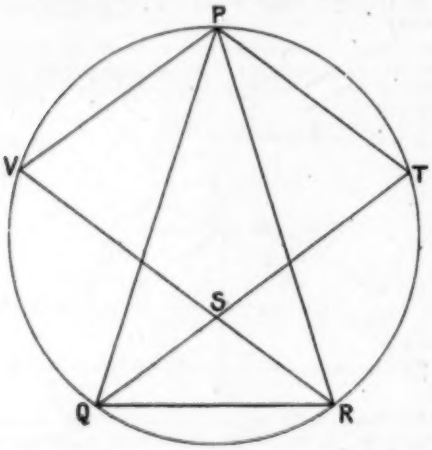
Then the perimeter of the triangle PST shall be equal to the sum of PQ, PR.

Join OQ, OR.

Proof.—Angle SOQ = Angle OQR, (I. 29.)
And angle SQO = Angle OQR, (Construction for inscribed circle)
Therefore, angle SOQ = Angle SQO, (Ax. 1.)
Wherefore, SO = SQ; (I. 6.)
Similarly it can be proved that TO = TR.
Therefore, perimeter of triangle PST = sum of sides PQ, PR.
Q. E. D.

9. What are the three main steps in the demonstration of Book IV., 10? (To describe an isosceles triangle, having each of the angles at the base double of the third angle.) PQR is such a triangle; the base angles are bisected by QST, RSV, which meet the circle described about the triangle at T, V respectively. Show that the figure PTSV is a rhombus.

The three main steps in the demonstration of IV. 10, are:—
(1) To prove that the base of the triangle touches the smaller circle.
(2) To prove that the lower triangle is isosceles.
(3) To prove that the third or upper triangle is isosceles.

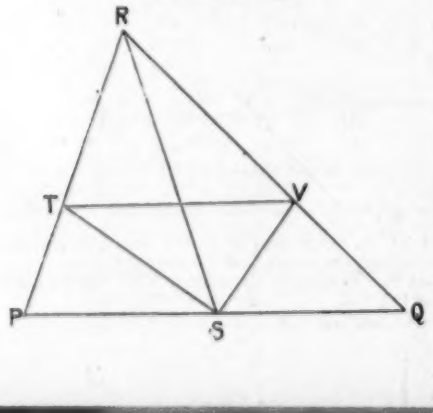


Proof.—Angle PRV = angle PQT, being halves of equal angles, (Hyp.)
Therefore, arc PV = arc PT, (III. 26.)
Wherefore, straight line PV = straight line PT. (III. 29.)
Again, angle VPQ = VRQ. (III. 21.)
Wherefore, angle VPQ = angle PQT,
And therefore PV is parallel to QT; (I. 27.)
Similarly it can be proved that PT is parallel to VR;
Therefore PTSV is a parallelogram, and its opposite sides are equal, that is, PV = ST, and PT = VS; (I. 34.)
But it has been proved that PV = PT;
Therefore PTSV is equilateral;
Wherefore PTSV is a rhombus.
Q. E. D.

10. If a straight line be drawn parallel to one of the sides of a triangle, it shall cut the other sides, or these produced, proportionally: and conversely, if the sides, or the sides produced, be cut proportionally, the straight line which joins the points of section shall be parallel to the remaining side of the triangle.

If the side PQ of the triangle PQR be bisected at S, and the angles RSP, RSQ be bisected by ST, SV, meeting PR, QR in T, V respectively, TV shall be parallel to PQ.

Proposition 2, Book VI.



Proof.—RT is to TP as RS is to SP, and RV is to VQ as RS is to SQ; (VI. 3.)
But SP = SQ; (Hyp.)
Therefore, RT is to TP as RV is to VQ,
Wherefore, TV is parallel to PQ. (VI. 2.)
Q. E. D.

11. Define similar rectilineal figures, reciprocal figures, proportion.

Equal parallelograms, which have one angle of the one equal to one angle of the other, have their sides about the equal angles reciprocally proportional: and conversely, parallelograms that have one angle of the one equal to one angle of the other, and their sides about the equal angles reciprocally proportional, are equal to one another.

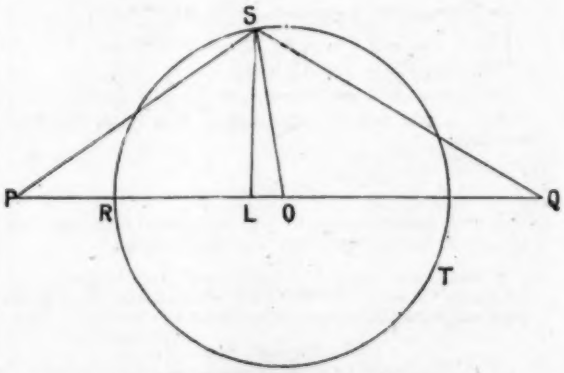
Similar rectilineal figures are those which have their several angles equal, each to each, and the sides about the equal angles proportionals.

Reciprocal figures, namely, triangles and parallelograms, are such as have their sides about two of their angles proportionals in such a manner, that a side of the first figure is to a side of the other, as the remaining side of this other is to the remaining side of the first.

Proportion.—The first of four magnitudes is said to have the same ratio to the second, that the third has to the fourth, when any equimultiples whatever of the first and the third being taken, and any equimultiples whatever of the second and the fourth, if the multiple of the first be less than that of the second, the multiple of the third is also less than that of the fourth, and if the multiple of the first be equal to that of the second, the multiple of the third is also equal to that of the fourth, and if the multiple of the first be greater than that of the second, the multiple of the third is also greater than that of the fourth.

Proposition 14, Book VI.

12. The base of a triangle is given, and its middle point is the centre of a fixed circle, on the circumference of which the vertex of the triangle lies: show that the sum of the squares on the two sides of the triangle is invariable.



Let PQ be the given base, and O the centre of the line.
Let a circle be drawn with O as centre as RST.
Then if straight lines be drawn to any point in the circumference of this circle from P and Q, the sum of the squares on these lines shall be invariable.
Take any point S, and join PS, QS, OS, and draw SL perpendicular to PQ. (I. 11.)

Proof.—Sq. on PS. = sq. on PO + sq. on OS less twice rect. PO, OL, (II. 13.)
And sq. on QS = sq. on QO + sq. on OS + twice rect. QO, OL; (II. 12.)
But, sq. on PO = sq. on QO,
And, rect. PO, OL = rect. QO, OL;
Therefore, sq. on PS + sq. on QS
= twice sq. on PO + twice square on OS
= twice sq. on half the base + twice square on the radius of the circle.
Wherefore the sum of the squares on the straight lines drawn to any point in the circumference is invariable, as it is always equal to twice the sum of the square on half the base and the square on the radius.
Q. E. D.

Male Candidates.

SECOND YEAR.

Algebra and Mensuration.

(Three hours allowed for this paper.)

Candidates are not permitted to answer more than NINE questions in Algebra and TWO in Mensuration.

The *solution* must be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered of no value.

Algebra.

1. Show that $a^{\frac{1}{n}} \times b^{\frac{1}{n}} = (ab)^{\frac{1}{n}}$.

What does a^0 denote?

Find the square root of $(x + x^{-1}) - 2(x^{\frac{1}{2}} - x^{-\frac{1}{2}}) - 1$.

Let $a^{\frac{1}{n}} \times b^{\frac{1}{n}} = x$;

$$\therefore x^n = \left(a^{\frac{1}{n}} \times b^{\frac{1}{n}}\right)^n$$
$$= \left(a^{\frac{1}{n}}\right)^n \times \left(b^{\frac{1}{n}}\right)^n$$
$$= a \times b$$
$$= ab,$$
$$\therefore x = (ab)^{\frac{1}{n}}.$$

Wherefore $a^{\frac{1}{n}} \times b^{\frac{1}{n}} = (ab)^{\frac{1}{n}}$.

$$a^n \times a^0 = a^{n+0} = a^n,$$
$$\therefore a^0 = \frac{a^n}{a^n}$$
$$= 1.$$

Square root of $(x + x^{-1}) - 2(x^{\frac{1}{2}} - x^{-\frac{1}{2}}) - 1$.

First Method.— $(x + x^{-1}) - 2(x^{\frac{1}{2}} - x^{-\frac{1}{2}}) - 1$

$$= x + \frac{1}{x} - 2x^{\frac{1}{2}} + \frac{2}{x^{\frac{1}{2}}} - 1$$
$$= x - 2x^{\frac{1}{2}} - 1 + \frac{2}{x^{\frac{1}{2}}} + \frac{1}{x}$$

$$\left(x - 2x^{\frac{1}{2}} - 1 + \frac{2}{x^{\frac{1}{2}}} + \frac{1}{x}\right)\left(x^{\frac{1}{2}} - 1 - \frac{1}{x^{\frac{1}{2}}}\right)$$

$$\begin{array}{l|l} x & \\ 2x^{\frac{1}{2}} - 1 & -2x^{\frac{1}{2}} - 1 \\ & -2x^{\frac{1}{2}} + 1 \\ \hline 2x^{\frac{1}{2}} - 2 - \frac{1}{x^{\frac{1}{2}}} & -2 + \frac{2}{x^{\frac{1}{2}}} + \frac{1}{x} \\ & -2 + \frac{2}{x^{\frac{1}{2}}} + \frac{1}{x} \\ \hline \end{array}$$

$$\therefore \text{Square root} = x^{\frac{1}{2}} - 1 - \frac{1}{x^{\frac{1}{2}}}$$
$$\text{or } \underline{x^{\frac{1}{2}} - x^{-\frac{1}{2}} - 1}.$$

Second Method.—$(x + x^{-1}) - 2(x^{\frac{1}{2}} - x^{-\frac{1}{2}}) - 1$

$$= x - 2x^{\frac{1}{2}} - 1 + 2x^{-\frac{1}{2}} + x^{-1}(x^{\frac{1}{2}} - 1 - x^{-\frac{1}{2}})$$

$$\begin{array}{l|l} x & \\ 2x^{\frac{1}{2}} - 1 & -2x^{\frac{1}{2}} - 1 \\ & -2x^{\frac{1}{2}} + 1 \\ \hline 2x^{\frac{1}{2}} - 2 - x^{-\frac{1}{2}} & -2 + 2x^{-\frac{1}{2}} + x^{-1} \\ & -2 + 2x^{-\frac{1}{2}} + x^{-1} \\ \hline \end{array}$$

$$\therefore \text{Square root} = x^{\frac{1}{2}} - 1 - x^{-\frac{1}{2}}$$
$$\text{or } \underline{x^{\frac{1}{2}} - x^{-\frac{1}{2}} - 1}.$$

2. Find the arithmetic, geometric, and harmonic means between a and b.

Given two fractions; show that two new fractions formed by taking as the numerators the arithmetic and geometric means of the original numerators, and taking as denominators the corresponding means of the original denominators, are each intermediate in value between the original fractions.

Let A denote the arithmetic mean, G the geometric mean, and H the harmonic mean.

Then,

$$A - a = b - A,$$
$$2A = a + b,$$
$$\therefore A = \tfrac{1}{2}(a + b).$$
$$\frac{G}{a} = \frac{b}{G}$$
$$G^2 = ab$$
$$\therefore G = \sqrt{ab}.$$
$$\frac{1}{H} - \frac{1}{a} = \frac{1}{b} - \frac{1}{H}$$
$$\frac{1}{H} + \frac{1}{H} = \frac{1}{a} + \frac{1}{b}$$
$$\frac{2}{H} = \frac{a + b}{ab}$$
$$\frac{H}{2} = \frac{ab}{a + b}$$
$$\therefore H = \frac{2ab}{a + b}.$$

Let $\frac{a}{b}$ and $\frac{c}{d}$ represent the two fractions, of which $\frac{a}{b}$ is the greater.

Then the two new fractions are

$$\tfrac{1}{2}(a + c) \text{ and } \frac{\sqrt{ac}}{\sqrt{bd}}$$
$$\text{or } \frac{a + c}{b + d} \text{ and } \sqrt{\frac{ac}{bd}}$$

$$\frac{a}{b} > \frac{c}{d}$$
$$\frac{a}{c} > \frac{b}{d}$$
$$\frac{a}{c} + 1 > \frac{b}{d} + 1$$
$$\frac{a + c}{c} > \frac{b + d}{d}$$
$$\therefore \underline{\frac{a + c}{b + d} > \frac{c}{d}}$$

$$\frac{a}{b} > \frac{c}{d}$$
$$\frac{d}{b} > \frac{c}{a}$$
$$\frac{d}{b} + 1 > \frac{c}{a} + 1$$
$$\frac{b + d}{b} > \frac{a + c}{a}$$
$$\therefore \underline{\frac{a}{b} > \frac{a + c}{b + d}}$$

Again,

$$\frac{a}{b} > \frac{c}{d}$$
$$\frac{a}{b} \times \frac{c}{d} > \frac{c}{d} \times \frac{c}{d}$$
$$\frac{ac}{bd} > \frac{c^2}{d^2}$$
$$\therefore \underline{\sqrt{\frac{ac}{bd}} > \frac{c}{d}}$$

$$\frac{a}{b} > \frac{c}{d}$$
$$\frac{a}{b} \times \frac{a}{b} > \frac{c}{d} \times \frac{a}{b}$$
$$\frac{a^2}{b^2} > \frac{ac}{bd}$$
$$\therefore \underline{\frac{a}{b} > \sqrt{\frac{ac}{bd}}}$$

$\therefore \frac{a + c}{b + d}$ and $\sqrt{\frac{ac}{bd}}$ are each intermediate in value between $\frac{a}{b}$ and $\frac{c}{d}$.

3. Simplify :—

(1) $\dfrac{x^4 + 1 + (x + 1)^4}{[x^2 + 1 + (x + 1)^2]^2}$

(2) $\dfrac{e^{x-y} + xy^{-1} + yx^{-1} + e^{y-x}}{xy^{-1}e^{x-y} + 2 + yx^{-1}e^{y-x}}$

(1) $\dfrac{x^4 + 1 + (x + 1)^4}{[x^2 + 1 + (x + 1)^2]^2}$

$$= \frac{x^4 + 1 + x^4 + 4x^3 + 6x^2 + 4x + 1}{(x^2 + 1 + x^2 + 2x + 1)^2}$$
$$= \frac{2x^4 + 4x^3 + 6x^2 + 4x + 2}{(2x^2 + 2x + 2)^2}$$
$$= \frac{2(x^4 + 2x^3 + 3x^2 + 2x + 1)}{4(x^2 + x + 1)^2}$$
$$= \frac{(x^2 + x + 1)^2}{2(x^2 + x + 1)^2}$$
$$= \underline{\tfrac{1}{2}}. \quad \text{Ans.}$$

(2) $\dfrac{e^{x-y}+xy^{-1}+yx^{-1}+e^{y-x}}{xy^{-1}e^{x-y}+2+yx^{-1}e^{y-x}}$

$$= \frac{xy^{-1}+e^{x-y}+e^{y-x}+x^{-1}y}{\left(x^{\frac{1}{2}}y^{-\frac{1}{2}}e^{\frac{x-y}{2}}+x^{-\frac{1}{2}}y^{\frac{1}{2}}e^{\frac{y-x}{2}}\right)^2}$$

$$= \frac{\left(x^{\frac{1}{2}}y^{-\frac{1}{2}}e^{\frac{x-y}{2}}+x^{-\frac{1}{2}}y^{\frac{1}{2}}e^{\frac{y-x}{2}}\right)\left(x^{\frac{1}{2}}y^{-\frac{1}{2}}e^{\frac{x-y}{2}}+x^{-\frac{1}{2}}y^{\frac{1}{2}}e^{\frac{y-x}{2}}\right)}{\left(x^{\frac{1}{2}}y^{-\frac{1}{2}}e^{\frac{x-y}{2}}+x^{-\frac{1}{2}}y^{\frac{1}{2}}e^{\frac{y-x}{2}}\right)^2}$$

$$= \frac{x^{\frac{1}{2}}y^{-\frac{1}{2}}e^{\frac{y-x}{2}}+x^{-\frac{1}{2}}y^{\frac{1}{2}}e^{\frac{x-y}{2}}}{x^{\frac{1}{2}}y^{-\frac{1}{2}}e^{\frac{x-y}{2}}+x^{-\frac{1}{2}}y^{\frac{1}{2}}e^{\frac{y-x}{2}}}$$

Multiplying by $x^{\frac{1}{2}}y^{\frac{1}{2}}e^{\frac{x-y}{2}}\Big\} = \dfrac{x+ye^{x-y}}{xe^{x-y}+y}$

$$= \underline{\frac{x+ye^{x-y}}{y+xe^{x-y}}} \quad \text{Ans.}$$

4. Find the number of permutations of n things taken r together.

How many different words may be made of the letters of the expression $a^3 e^3 b^4 c$?

Suppose there are n letters $a, b, c, d, \ldots\ldots$; put a before each of the other letters, and we thus obtain $(n-1)$ permutations in which a stands first. Next put b before each of the other letters, and we obtain $(n-1)$ permutations in which b stands first.

Similarly there are $(n-1)$ permutations in which c stands first; and so on. Thus, on the whole, there are $n(n-1)$ permutations of n letters taken two at a time.

Out of n letters we can form $n(n-1)$ permutations each of two letters; hence out of the $n-1$ letters $b, c, d, \ldots\ldots$ we can form $(n-1)(n-2)$ permutations each of two letters; put a before each of these, and we have $(n-1)(n-2)$ permutations each of three letters in which a stands first.

Similarly there are $(n-1)(n-2)$ permutations each of three letters in which b stands first. Similarly there are as many in which c stands first; and so on.

Thus, on the whole, there are $n(n-1)(n-2)$ permutations of n letters taken three at a time.

From these cases it might be *conjectured* that the number of permutations of n letters taken r at a time is

$$n(n-1)(n-2)\ldots\ldots(n-r+1),$$

and this is the case.

For, suppose it is true that the number of permutations of n letters taken $r-1$ at a time is

$$n(n-1)(n-2)\ldots\ldots[n-(r-1)+1],$$

it can be shown that a similar formula will give the number of the permutations of the letters taken r at a time.

For out of the $n-1$ letters $b, c, d, \ldots\ldots$

$$(n-1)(n-2)\ldots\ldots[n-1-(r-1)+1]$$

permutations each of $r-1$ letters can be formed; put a before each of these, and we obtain as many permutations each of r letters in which a stands first.

Similarly we have as many in which b stands first, as many in which c stands first, and so on.

Thus, on the whole, there are

$$n(n-1)(n-2)\ldots\ldots(n-r+1)$$

permutations of n letters taken r at a time,

If then the formula holds when the letters are taken $r-1$ at a time, it will hold when they are taken r at a time.

It has been proved to hold when they are taken three at a time, therefore it holds when they are taken four at a time, therefore it holds when they are taken five at a time, and so on.

Thus it holds universally.

In the expression $a^3 e^3 b^4 c$, the letter a occurs twice, e three times, b four times, and c once, and number of letters = 10.

$$\therefore \text{No. of words} = \frac{\lfloor 10}{\lfloor 2 \,\lfloor 3 \,\lfloor 4}$$

$$= \frac{10.9.8.7.6.5}{2.2.3}$$

$$= \underline{12{,}600.} \quad \text{Ans.}$$

5. Investigate a method for extracting the square root of a binomial surd, one of whose terms is rational, the other a quadratic surd.

Prove that in the equation $x^2 - x = 2 + \sqrt{5}$, one root is the square of the other.

Let $a + \sqrt{b}$ be the given binomial, and suppose

$$\sqrt{a+\sqrt{b}} = \sqrt{x} + \sqrt{y},$$

Then, $\sqrt{a-\sqrt{b}} = \sqrt{x} - \sqrt{y}$;

By multiplication, $\sqrt{a^2-b} = x - y$;

By squaring both sides of the first equation,

$$a + \sqrt{b} = x + 2\sqrt{xy} + y,$$

$$\therefore a = x + y;$$

Hence, by addition and subtraction,

$$a + \sqrt{a^2-b} = 2x, \text{ and } a - \sqrt{a^2-b} = 2y,$$

$$\therefore x = \tfrac{1}{2}(a + \sqrt{a^2-b})\Big\}$$
$$y = \tfrac{1}{2}(a - \sqrt{a^2-b})\Big\}$$

Thus x and y are known, and therefore $\sqrt{a+\sqrt{b}}$, which is $\sqrt{x} + \sqrt{y}$, is known.

Also $\sqrt{a-\sqrt{b}}$ is known, for it is $\sqrt{x} - \sqrt{y}$.

$$x^2 - x = 2 + \sqrt{5}$$

$$x^2 - x - (2 + \sqrt{5}) = 0$$

$$\therefore \text{Roots are } \frac{1+\sqrt{1+4(2+\sqrt{5})}}{2} \text{ and } \frac{1-\sqrt{1+4(2+\sqrt{5})}}{2}$$

$$= \frac{1+\sqrt{9+4\sqrt{5}}}{2} \text{ and } \frac{1-\sqrt{9+4\sqrt{5}}}{2};$$

Let $\sqrt{9+4\sqrt{5}} = \sqrt{x} + \sqrt{y}$,

Then, $\sqrt{9-4\sqrt{5}} = \sqrt{x} - \sqrt{y}$,

$$\therefore 81 - 16 \times 5 = x - y$$

$$1 = x - y;$$

$$9 + 4\sqrt{5} = x + y + 2\sqrt{xy}$$

$$\therefore 9 = x + y;$$

$$2x = 10 \text{ and } 2y = 8$$

$$\therefore x = 5 \text{ and } y = 4.$$

$$\therefore \sqrt{9+4\sqrt{5}} = \sqrt{5} + \sqrt{4}$$

$$= \sqrt{5} + 2$$

$$\text{Wherefore Roots} = \frac{1+\sqrt{5}+2}{2} \text{ and } \frac{1-(\sqrt{5}+2)}{2}$$

$$= \frac{3+\sqrt{5}}{2} \text{ and } \frac{-1-\sqrt{5}}{2};$$

$$\text{Now, } \left(\frac{-1-\sqrt{5}}{2}\right)^2 = \frac{1+2\sqrt{5}+5}{4}$$

$$= \frac{6+2\sqrt{5}}{4}$$

$$= \frac{3+\sqrt{5}}{2};$$

$\therefore$ One root is the square of the other.

6. In the expansion of $(1+x)^n$, the coefficients of terms, equally distant from the beginning and end, are the same, when the index is a positive integer.

Show that in the same expansion, the sum of the even coefficients is equal to the sum of the odd coefficients.

In the expansion of $(1+x)^n$, the coefficient of the rth term from the beginning

$$= \frac{n(n-1)(n-2)\ldots(n-r+2)}{\lfloor r-1},$$

Multiplying numerator and denominator by $\lfloor n-r+1$ this becomes $\dfrac{\lfloor n}{\lfloor r-1 \,\lfloor n-r+1}$.

The rth term from the end is the $(n - r + 2)$th term from the beginning, and its coefficient is

$$\frac{n(n-1)\ldots[n-(n-r+2)+2]}{\lfloor n-r+1} \cdot$$

$$= \frac{n(n-1)\ldots r}{\lfloor n-r+1};$$

Multiplying numerator and denominator by $\lfloor r-1$ this becomes

$$\frac{\lfloor n}{\lfloor r-1 \;\; \lfloor n-r+1} \cdot$$

∴ Coefficients of terms, equally distant from the beginning and end, are the same.

In the expansion of $(1+x)^n$, put $x = -1$; then

$$0 = 1 - n + \frac{n(n-1)}{1.2} - \frac{n(n-1)(n-2)}{1.2.3} + \ldots$$

= sum of odd coefficients − sum of even coefficients;

∴ Sum of even coefficients = sum of odd coefficients.

7. Show that the logarithm of a number to the base b may be found by multiplying the logarithm of the given number to the base a by $\log_b a$.

Given $\log 2 = .30103$, find $\log 5$, $\log .016$, $\log 1\frac{1}{2}$, $\log 15\frac{5}{8}$.

Let $x = \log_a n$, $y = \log_b n$

∴ $n = a^x$ and $= b^y$,

$a^x = b^y$

$a = b^{\frac{y}{x}}$

$\frac{y}{x} = \log_b a$

∴ $y = x \log_b a$;

Hence the logarithm of a number to the base b may be found by multiplying the logarithm of the given number to the base a by $\log_b a$.

Log 5 = $\log \frac{10}{2}$
= log 10 − log 2
= 1 − .30103
= .69897.

Log .016 = $\log \frac{16}{1000}$
= log 16 − log 1000
= $\log 2^4 - 3$
= 4 log 2 − 3
= (.30103 × 4) − 3
= 1.20412 − 3
= − 1.79588
or $\bar{2}.20412$.

Log $1\frac{1}{2}$ = log 1.6
= $\log \frac{16}{10}$
= log 16 − log 10
= 1.20412 − 1
= .20412.

Or, Log $1\frac{1}{2}$ = log 1.6
= log (.016 × 100)
= log .016 + log 100
= $\bar{2}.20412 + 2$
= .20412.

Log $15\frac{5}{8}$ = $\log \frac{125}{8}$
= log 125 − log 8
= $\log 5^3 - \log 2^3$
= 3 log 5 − 3 log 2
= (.69897 − .30103) × 3
= .39794 × 3
= 1.19382.

Or, Log $15\frac{5}{8}$ = $\log \frac{125}{8}$
= $\log \frac{1000}{64}$
= log 1000 − log 64
= $3 - \log 2^6$
= 3 − (.30103 × 6)
= 3 − 1.80618
= 1.19382.

8. Find the amount of an annuity left unpaid for any number of years, allowing simple interest upon each sum from the time it becomes due.

A sum of £P is left to A and B so that at the end of a and b years (when they will respectively be of age) their shares put out at compound interest at r per cent. per annum will be equal. Find how much is left to each of them.

Let A be the annuity, n the number of years, r the interest of one pound in one year, and M the amount.

At the end of the first year A becomes due, and at the end of the second year the interest of the first annuity is rA; at the end of this year the principal becomes 2A, therefore the interest due at the end of the third year is $2r$ A; in the same way the interest due at the end of the fourth year is $3r$ A, and so on; hence the whole interest is

$$rA + 2rA + 3rA + \ldots\ldots + (n-1)rA$$

that is, $rA(1 + 2 + 3 + \ldots\ldots + n - 1)$

$$= \frac{n(n-1)}{2} r\,A;$$

and the sum of the annuities is nA;

$$\therefore M = nA + \frac{n(n-1)}{2} r\,A.$$

Let x = sum in pounds left to A,

Then P − x = ,, ,, B;

∴ Amount of A's principal at compound interest

$$= x(1+r)^a,$$

Amount of B's principal at compound interest

$$= (P - x)(1+r)^b;$$

$$\therefore x(1+r)^a = (P-x)(1+r)^b$$
$$= P(1+r)^b - x(1+r)^b$$
$$x(1+r)^a + x(1+r)^b = P(1+r)^b$$
$$x[(1+r)^a + (1+r)^b] = P(1+r)^b$$
$$\therefore x = \frac{P(1+r)^b}{(1+r)^a + (1+r)^b}.$$
$$P - x = P - \frac{P(1+r)^b}{(1+r)^a + (1+r)^b}$$
$$= \frac{P(1+r)^a}{(1+r)^a + (1+r)^b}.$$

∴ Sum left to A = £$\frac{P(1+r)^b}{(1+r)^a + (1+r)^b}$,

,, B = £$\frac{P(1+r)^a}{(1+r)^a + (1+r)^b}$;

or, Sum left to A = amount of £P for b years divided by the sum of the amounts of £1 for a years and b years,

And, Sum left to B = amount of £P for a years divided by the same divisor.

9. Solve the equations:—

$$(1)\ x^4 + 5 - 2\sqrt{x^2-2} = 5x^2$$
$$(2)\ \begin{cases} 2x^2 + 3y^2 - xy = 31 \\ x - y = 3 \end{cases}$$

$$(1)\ x^4 + 5 - 2\sqrt{x^2-2} = 5x^2$$
$$x^4 - 4x^2 + 4 = x^2 + 2\sqrt{x^2-2} - 1$$
$$(x^2-2)^2 = (x^2-2) + 2\sqrt{x^2-2} + 1$$

Extracting square root of each side } $x^2 - 2 = \sqrt{x^2-2} + 1$

$$(x^2-2) - \sqrt{x^2-2} = 1$$

Completing the square } $(x^2-2) - \sqrt{x^2-2} + (\frac{1}{2})^2 = 1 + \frac{1}{4}$

$$= \frac{5}{4}$$

Extracting square root } $\sqrt{x^2-2} - \frac{1}{2} = \frac{\pm\sqrt{5}}{2}$

$$\sqrt{x^2-2} = \frac{\pm\sqrt{5}+1}{2}$$

Squaring each side } $x^2 - 2 = \frac{5 \pm 2\sqrt{5} + 1}{4}$

$$= \frac{3 \pm \sqrt{5}}{2}$$

$$x^2 = \frac{7 \pm \sqrt{5}}{2}$$

$$\therefore x = \pm\sqrt{\tfrac{1}{2}(7 \pm \sqrt{5})}.$$

Another method from

$$x^2 - 2 = \sqrt{x^2 - 2} + 1$$
$$x^2 - 3 = \sqrt{x^2 - 2}$$

Squaring each side $\}$ $x^4 - 6x^2 + 9 = x^2 - 2$

$$x^4 - 7x^2 = -11$$
$$x^4 - 7x^2 + (\tfrac{7}{2})^2 = \tfrac{49}{4} - 11$$
$$= \tfrac{5}{4}$$
$$x^2 - \tfrac{7}{2} = \frac{\pm\sqrt{5}}{2}$$
$$x^2 = \frac{7 \pm \sqrt{5}}{2}$$
$$\therefore x = \pm\sqrt{\tfrac{1}{2}(7 \pm \sqrt{5})}.$$

(2) (1) $2x^2 + 3y^2 - xy = 31$ $\}$
(2) $x - y = 3$ $\}$

From (2)] $y = x - 3$.

(1) $2x^2 + 3(x-3)^2 - x(x-3) = 31$
$2x^2 + 3(x^2 - 6x + 9) - x^2 + 3x = 31$
$x^2 + 3x + 3x^2 - 18x + 27 = 31$
$4x^2 - 15x = 4$
$$x^2 - \frac{15x}{4} = 1$$
$$x^2 - \frac{15x}{4} + (\tfrac{15}{8})^2 = 1 + \tfrac{225}{64}$$
$$= \frac{64 + 225}{64}$$
$$= \tfrac{289}{64}$$
$$x - \tfrac{15}{8} = \pm\tfrac{17}{8}$$
$$x = \pm\tfrac{17}{8} + \tfrac{15}{8}$$
$\therefore x = 4$, or $-\frac{1}{4}$.

And $y = x - 3$
$= 4 - 3$, or $-\frac{1}{4} - 3$
$= 1$, or $-3\frac{1}{4}$.

$\therefore x = 4$, or $-\frac{1}{4}$ $\}$
$y = 1$, or $-3\frac{1}{4}$ $\}$ Ans.

10. A man bought a number of £100 railway shares when they were at a certain rate per cent. discount for £900, and afterwards when they were at the same rate per cent. premium sold all but one of them for £990. How many were they, and what did each cost?

Let x = rate per cent. discount and premium,
Then, $100 - x$ = price in pounds when bought,
And, $100 + x$ = " " sold;

$$\therefore \frac{900}{100 - x} = \frac{990}{100 + x} + 1$$
$$900(100 + x) = 990(100 - x) + (100 + x)(100 - x)$$
$$90{,}000 + 900x = 99{,}000 - 990x + 10{,}000 - x^2$$
$$x^2 + 1890x = 19{,}000$$
$$x^2 + 1890x + (945)^2 = 19{,}000 + 893{,}025$$
$$= 912{,}025$$
$$x + 945 = \pm 955$$
$$x = \pm 955 - 945$$
$\therefore x = 10$, or $-1{,}900$.

The minus sign is inapplicable.

$\therefore$ Price of each share = £100 − £10
= £90;
Number of shares = £900 ÷ £90
= 10.

11. A merchant starts in business with £4,000 capital. In the first year he makes a certain percentage of profit, from which he takes £300 for expenses, and adds the rest to his capital. Next year he makes the same percentage of profit, and having again spent £300, finds he has £5,100 left in the business. What percentage of profit did he make?

Let x = Percentage of profit;

Then, $\left[4000\left(1 + \frac{x}{100}\right) - 300\right]\left(1 + \frac{x}{100}\right) - 300$
$= 5100$

$$(4000 + 40x - 300)\left(1 + \frac{x}{100}\right) = 5100 + 300$$
$$(3700 + 40x)\left(1 + \frac{x}{100}\right) = 5400$$
$$3700 + 37x + 40x + \frac{2x^2}{5} = 5400$$
$$\frac{2x^2}{5} + 77x = 5400 - 3700$$
$$= 1700$$
$$x^2 + 77x \times \tfrac{5}{2} = 1700 \times \tfrac{5}{2}$$
$$x^2 + \frac{385x}{2} = 4250$$
$$x^2 + \frac{385x}{2} + (\tfrac{385}{4})^2 = 4250 + \tfrac{148225}{16}$$
$$= \frac{68000 + 148225}{16}$$
$$= \tfrac{216225}{16}.$$
$$x + \tfrac{385}{4} = \pm\tfrac{465}{4}$$
$$x = \pm\tfrac{465}{4} - \tfrac{385}{4}$$
$\therefore x = 20$, or $-\frac{385}{4}$.

The minus sign is inapplicable.

$\therefore$ Percentage of profit = 20.

Mensuration.

($\pi = 3\frac{1}{7}$.)

1. Find the edges of a cube whose solidity is equal to that of a rectanglar parallelopiped whose edges are 9 ft. 4 in., 21 ft. 4 in., 32 ft. 8 in.

Length of edge $= \sqrt[3]{9\frac{1}{3}\text{ ft.} \times 21\frac{1}{3}\text{ ft.} \times 32\frac{2}{3}\text{ ft.}}$
$= \frac{1}{3}\sqrt{28 \times 64 \times 98}$ ft.
$= \frac{1}{3}\sqrt[3]{7 \times 4 \times 64 \times 49 \times 2}$ ft.
$= \frac{1}{3}(7 \times 2 \times 4)$ ft.
$= \frac{56}{3}$ ft.
= 18 ft. 8 in. Ans.

2. Find the cost of gilding the surface of a cone whose altitude is 12 feet and the diameter of its base is 10 feet, at ½d. per sq. in., including the base.

Slant height $= \sqrt{12^2 + 5^2}$ ft.
$= \sqrt{144 + 25}$ ft.
$= \sqrt{169}$ ft.
= 13 ft.

Area of surface of cone
= ½ (perimeter of base × slant height) + area of base
$= [\frac{1}{2}(10 \times 3\frac{1}{7} \times 13) + (5^2 \times 3\frac{1}{7})]$ sq. ft.
$= [(65 + 25) \times 3\frac{1}{7}]$ sq. ft.
$= (90 \times 3\frac{1}{7})$ sq. ft.

Cost of gilding $= (90 \times 3\frac{1}{7} \times 3)$s.
$= £\frac{9 \times 11 \times 3}{7}$
$= £\frac{297}{7}$
= £42 8s. 6⅜d. Ans.

3. Find the weight of a spherical shell whose diameter is 17 inches, the thickness of the metal being $1\frac{1}{4}$ inches and a cubic inch of it weighing $\frac{1}{4}$ lb.

Solidity of shell $= \frac{4}{3}\pi[(\frac{17}{2})^3 - (\frac{17}{4} - \frac{2}{8})^3]$ cub. in.
$= \frac{4}{3} \times \frac{22}{7}[\frac{4913}{8} - (\frac{17}{8})^3]$ cub. in.
$= \frac{11}{21}[4913 - \frac{314432}{64}]$ cub. in.
$= \frac{11}{21}\left[\frac{314432 - 205379}{64}\right]$ cub. in.
$= \frac{11 \times 109053}{21 \times 64}$ cub. in.;

Weight of shell $= \frac{11 \times 5193}{64 \times 4}$ lbs.
$= \frac{57123}{256}$ lbs.
$= 223\frac{35}{256}$ lbs.
= 1 cwt. 3 qrs. $27\frac{35}{256}$ lbs.
or 2 cwt. nearly. Ans.

Quarterly Arithmetical Tests.

STANDARD I.—FIRST QUARTER.

1. 8, 43, 2, 570, 19

2. 596, 34

3. 827, 801

4. 6×2; 3×3; 2×4.

SECOND QUARTER.

1. 26, 305, 7, 593, 80

2. 460, 219

3. 348, 76

4. 9×3; 8×4; 11×5.

THIRD QUARTER.

1. 159, 430, 672, 908, 763

2. 702, 695

3. 400, 7

4. 9×4; 12×5; 7×6.

STANDARD II.—FIRST QUARTER.

1. 95 + 4,070 + 6 + 30,819 + 503 + 7,628.

2. From 43,001 take 39,968.

3. 67,049 × 59.

4. 12 × 8; 11 × 10; 9 × 12.

SECOND QUARTER.

1. 83,564 × 708.

2. 30,402 ÷ 6. Write the answer in words.

3. There are 30 boys in a class. If each have four sums to do, and they get only 98 right, how many are wrong?

4. 47d.; 63d.; 76d.

THIRD QUARTER.

1. 56,506 ÷ 12.

2. 96,478 × 650.

3. If there are 49 rows of trees in an orchard, and 156 trees in a row, how many trees are there in the orchard?

4. 94d.; 103d.; 140d.

STANDARD III.—FIRST QUARTER.

1. 43,810 ÷ 26.

2. How often is eighty-seven contained in seven hundred thousand two hundred and sixty-three?

3. Divide half a million by 694.

4. In a division sum the divisor is 470, the quotient 5,609, and the remainder 370. What is the dividend?

SECOND QUARTER.

1. From sixty-five pounds take thirty-nine pounds twelve shillings and seven pence farthing.

2. What is the sum of seven pounds fourteen shillings and ten pence, fifteen shillings and eight pence three-farthings, nineteen pounds and three pence halfpenny, twelve shillings and eleven pence three-farthings, eight pounds ten shillings and sixpence, and nineteen shilliugs and five pence farthing?

3. Find the fifty-ninth part of four hundred thousand and twenty.

4. If you take the sum of 30 farthings, 30 halfpence, 30 pence, and 30 shillings from 30 pounds, how much remains?

THIRD QUARTER.

1. £6,004 17s. $3\frac{1}{2}$d. + £37 19s. $11\frac{1}{4}$d. + £19,020 16s. $8\frac{3}{4}$d. + £9 13s. $10\frac{1}{2}$d. + £700 12s. $5\frac{3}{4}$d. + £8,263 18s. 4d.

2. Nine hundred and thirty-two nuts were given to 37 boys and 29 girls. Each girl received 13, and the remainder were divided equally among the boys. How many did each boy get?

3. Take eight thousand three hundred and five pounds fifteen shillings and seven pence halfpenny from twenty thousand one hundred and four pounds ten shillings and six pence farthing.

4. A man earns twenty-five shillings a week and spends a guinea. How much does he save in a year?

STANDARD IV.—FIRST QUARTER.

1. £1 19s. $8\frac{3}{4}$d. × 111.

2. £4,187 13s. $7\frac{1}{2}$d. ÷ 6.

3. What is gained by buying 47 yards of cloth for 15 guineas, and selling it at 8s. 9d. per yard?

4. If a gentleman's income is one thousand pounds a year, and he saves £142 5s., how much does he spend daily?

SECOND QUARTER.

1. What is the railway fare for three hundred miles at three half-pence a mile?

2. Reduce 87 chains 19 yds. 1 ft. 11 in. to inches.

3. How many pints of rum are equal to $2\frac{1}{2}$ hhds.?

4. Two cheeses, one weighing 2 qrs. 18 lbs. and the other half as much, were bought at $8\frac{1}{2}$d. per pound. What was the total cost?

THIRD QUARTER.

1. A postman walks 8 miles a day and takes one step at every yard; how many steps will he take in 6 days?

2. How many times would 2 a. 1 r. 25 po. be contained in 77 acres?

3. Find the value of 75 lbs. 8 oz. of gold at £3 17s. 10½d. per ounce.

4. A railway train travels at the rate of 36 miles an hour. How far will it have gone between half-past nine in the morning and a quarter-past four in the afternoon?

STANDARD V.—FIRST QUARTER.

1. What is the cost of five thousand and two vases at 7s. 11d. per pair?

2. Find the price of three million fifty-seven thousand nine hundred articles at £7 16s. 8¾d. per hundred.

3. What is the expense of draining 6 fur. 34 po. at £29 13s. 4d. per mile?

4. Find the value of a crop on 35 a. 3 r. 24 po., at £11 9s. 2d. an acre.

SECOND QUARTER.

1. I borrowed £210 for 6 months; how long ought I to lend £180 in return?

2. Make a bill for:—
   75 yards of cloth at 7s. 9d. per yard;
   28½ yards of diaper at 1s. 8d. per yard;
   49 yards of muslin at 11½d. per yard;
   15 hats at 12s. 3d. each;
   37 umbrellas at 17s. 6d. each.

3. If I can travel 169 miles for £2 2s. 3d., how far can I travel for £5 1s. 4½d.?

4. A basket contains apples and oranges worth altogether £3. The apples are worth £1 11s. 3d., and the oranges 1½d. each. How many oranges are there?

THIRD QUARTER.

1. Take $\frac{5}{9}$ from $\frac{4}{7} + \frac{2}{3}$.

2. I have ¼ of an apple and cut off ⅓; what part of the apple remains?

3. If a person owe £450, and he can pay only £270, what will his creditors lose in the £?

4. Take from £2, the sum of ⅓, ⅛, and ⅓ of £2.

STANDARD VI.—FIRST QUARTER.

1. If you prefer the biggest share, would you have $\frac{5}{9}$, $\frac{6}{11}$, or $\frac{7}{13}$ of a box of figs?

2. Simplify:— $\dfrac{8\frac{2}{13} - 3\frac{5}{13}}{\frac{5}{13} \text{ of } 3\frac{1}{7}}$.

3. Multiply ·306 by 30·6, and divide the product by ·0027.

4. What is the difference between $\dfrac{\cdot 875}{\cdot 05}$ and (·875 × ·05)?

SECOND QUARTER.

1. Add together £7·025, $\frac{1}{8}$ of 3s. 9d., ·375 of a guinea, and $\frac{7}{11}$ of 7s. 4d.

2. If $\frac{3}{4}$ of $\frac{2}{7}$ of an estate be worth £2,520, what is the whole estate worth?

3. What decimal of two guineas is $\cdot 4\dot{6}$ of a crown?

4. If 3 men or 8 boys can do a piece of work in 21 days, in what time would 5 men and 16 boys do it?

THIRD QUARTER.

1. What is the simple interest on £228 13s. 4d. for 3 years 9 months at 3½ per cent.?

2. If a collector, who is paid 5 per cent. commission, receives £8 15s. for his trouble, how much has he collected?

3. If an ounce of gold be worth £3·$1\dot{6}$, find the value of 5·$0\dot{3}$ lbs.

4. What sum will produce £45 in 3 years at 4 per cent.?

STANDARD VII.—FIRST QUARTER.

1. If the interest on a certain sum at 3¾ per cent. is £11 5s. less than on an equal sum at 5¼ per cent., what is the sum?

2. If 20 men can mow 75 acres in 16 days, how many men will be required to mow 135 acres in 12 days?

3. In what time will £275 gain £43 6s. 3d. at 4½ per cent.?

4. If 70 soldiers can be fed 60 days for £270, how much will it cost to feed an army of 350,000 for a year at the same rate?

SECOND QUARTER.

1. Find the present worth of £978 due in 6 months at 3¾ per cent.

2. A cricketer had an average of 30 runs in 8 innings. In the first six he got 6, 38, 23, 46, 0, and 27 respectively. In the eighth he had four times as many as in the seventh. How many did he obtain in the eighth innings?

3. For what sum must goods worth £720 be insured at 4 per cent., so that in case of loss the value of the goods and the premium may be recovered?

4. The circumference of a circle is 3½ times the diameter. What is the diameter of a wheel which revolves 504 times in a mile?

THIRD QUARTER.

1. What per centage of 4 tons is 3 cwt.?

2. Find the amount at compound interest of £400 for 2 years at 4 per cent.

3. If eggs were bought at 11 for a shilling, and sold at 1½d. each, what was the gain per cent.?

4. A person invested £700 in the Three per Cents. at 87⅜, and sold out when the stock had risen to 90½. What was his gain, reckoning the usual brokerage in both transactions?

ANSWERS.

STANDARD I.

	FIRST.	SECOND.	THIRD.
1.	642.	1,011.	2,932.
2.	562.	241.	7.
3.	26.	272.	393.
4.	12; 9; 8.	27; 32; 55.	36; 60; 42.

STANDARD II.

	FIRST.	SECOND.
1.	43,121.	59,163,312.
2.	3,033.	5,067.
3.	3,955,891.	22 sums.
4.	96; 110; 108.	3s. 11d.; 5s. 3d.; 6s. 4d.

THIRD.

1. 4,708 + 10.
2. 62,710,700.
3. 7,644 trees.
4. 7s. 10d.; 8s. 7d.; 11s. 8d.

STANDARD III.

	FIRST.	SECOND.	THIRD.
1.	1,685.	£25 7s. 4⅔d.	£34,037 18s. 7¼d.
2.	8,049.	£37 13s. 9½d.	15 nuts.
3.	720 + 320.	6,780.	£11,798 14s. 10¾d.
4.	2,636,600.	£28 5s. 7½d.	£10 8s.

STANDARD IV.—FIRST.

1. £220 9s. 11½d.
2. £697 18s. 11¼d.
3. £4 16s. 3d.
4. £2 7s.

SECOND.

1. £1 17s. 6d.
2. 69,611 inches.
3. 1,260 pints.
4. £3 18s. 7½d.

THIRD.

1. 84,480 steps.
2. 32 times.
3. £3,535 10s. 6d.
4. 243 miles.

STANDARD V.—FIRST.

1. £989 19s. 7d.
2. £239,631 1s. 2¼d.
3. £25 8s. 0⅓d.
4. £411 7s. 1d.

SECOND.

1. 7 months.
2. £29 1s. 3d. + £2 7s. 6d. + £2 6s. 11½d. + £9 3s. 9d. + £32 7s. 6d. = £75 6s. 11½d.
3. 405⅓ miles.
4. 230 oranges.

THIRD.

1. ⅘.
2. ⅓.
3. 8s.
4. £1 0s. 4d.

STANDARD VI.

	FIRST.	SECOND.	THIRD.
1.	⅝.	£7 19s. 3½d.	£30 0s. 3d.
2.	2⅔.	£3,920.	£175.
3.	3,468.	·05.	£191 5s. 4d.
4.	17·45625.	9 days.	£375.

STANDARD VII.

	FIRST.	SECOND.	THIRD.
1.	£750.	£960.	3⅜ per cent.
2.	48 men.	80 runs.	£432 12s. 9⅜d.
3.	3½ years.	£750.	37½ per cent.
4.	£8,212,500.	3⅓ feet.	£20.

How my School was Examined.

BY THE

HEAD MASTER OF A LANCASHIRE SCHOOL.

STANDARD I.

For the examination in *Writing* the boys were placed back to back, and the following set of words was dictated:

Moment, Quiet, Stick, Glass, Wool, Shelf, Drove, Lady, Curtain, Once.

In *Arithmetic* two sets of sums were dictated for alternate boys:

A. (1) 295 + 139 + 484 + 276 + 65 (2) 207 + 138 (3) 634 + 195

B. (1) 350 + 69 + 148 + 535 + 27 (2) 615 + 438 (3) 720 + 463

Answers:—*A.* (1) 1259; (2) 69; (3) 439.
B. (1) 1129; (2) 177; (3) 257.

Mental Arithmetic questions:

If this slate cost 2d., how many can I get for 1s.?

I put 14d. in the bank, how much is that less than 2s.?

3d. is how much short of half-a-crown?

How many twos in 8?

4 + 9 + 3 + 7 + 8 = &c.

In examining the *Reading* the inspector was very sharp: boys had to read without any hesitancy or stumbling.

Geography was tested by a blank map of England placed in front of the class, and such questions as the following were asked:

What is this? (pointing to the map). What map? Show me the south, east, west. What is opposite to the west? Show me the south of the land—the east. What are these dots for? (towns). Show me some mountains. Show me a county—an island—the coastline.

On a plan of the school, such questions as these were asked: Show me the door I came in by—the door leading to the playground—the room you are sitting in—the master's desk. Where are the 2nd Standard boys sitting?—the 3rd Standard? &c.

STANDARD II.

In *Arithmetic* two sets of sums were given:

A. (1) 37207 − 15089.
(2) 63089 × 609.
(3) 50723 ÷ 9.
(4) A woman had 20 dozen eggs. She took them to market and sold 56. How many did she take home again?

B. (1) 13085 − 9096.
(2) 19709 × 870.
(3) 51025 ÷ 8.
(4) If a girl has a book with 315 pages in, how many days will it take her to read it, supposing she reads nine pages every day?

Answers:—*A.* (1) 22118; (2) 38421201; (3) 5635 + 8; (4) 184.
B. (1) 3989; (2) 17146830; (3) 6378 + 1; (4) 35 days.

Questions in *Mental Arithmetic*:—

How many cakes could you get for 1s. at 2 for 1½d.?
Add together 9d., 8d., 7d., 6d., 5d.
How many halfpence in 7½d.?
How many buns at 1½d. each for 1s.?
Divide 184 by 4. Divide 36 by 4.

The following passage was given for *Dictation* from the New Royal Reader, No. II.:—

The king's son, seeing pearls and diamonds fall from her mouth as she spoke, desired her to tell him the cause of such a wonder. So the good girl told him all that had taken place at the fountain. The prince was so charmed with her beauty and goodness that he asked her to become his wife.

Questions in *Geography*: What are the zones?—River-basins?—Islands?—Lakes?
What country do you live in?
What part of the world is the Arctic Ocean in?
What side of the equator are you on?
What continent do we live in? &c.

For the *Grammar* test the boys had to pick out of a reading-book nouns and verbs, and to tell the inspector all they could about each. Questions were also asked as, Why is such a word a noun? What is the singular? Why is the noun masculine? Why is the verb regular?

STANDARD III.

In *Arithmetic*, cards, of which the following is a sample, were used:

1. A sum in compound addition.

2. Divide a quarter of a million by 29.

3. A man bought a cart for £5 4s. 6d., and a horse for £3 14s. 6d. more than the cart; how much did the horse and cart cost?

4. A man has £10,000; he pays away £300 17s. 6d., how much has he left?

On other cards were such problems as these:

1. Three dozen chairs and 7 tables cost 400 shillings: if each table cost 16s., what was the price of each chair?

2. Four cakes apiece were provided for 125 children; 25 were absent: how many cakes did each child receive?

3. A man buys a pony and trap for 31 guineas; he pays £21 for the pony. How much less did he pay for the trap than for the pony?

Answers:—Card; (2) 8620 + 20; (3) £14 3s. 6d.; (4) £9699 2s. 6d.

Problems:—(1) 8s.; (2) 5 cakes; (3) £9 9s.

For *Dictation* the following passage was given:—

'Nothing could exceed the satisfaction caused by this event. The king and the queen and all the courtiers were unbounded in their admiration of pussy. At first the queen was frightened to touch an animal of such powers, but after awhile when she saw that pussy kept quiet, she ventured to stroke her on the back. Pussy at once jumped on the queen's knee, and commenced purring, to her great delight.'

Questions in *Geography*:—

What is the chief town in Yorkshire? What is a shire? What is the Pennine range sometimes called? Name a town in Yorkshire which does not manufacture woollen goods. What towns are in North Staffordshire? What towns are on the Mersey? What seaport is on the south of England? Tell me a town in the Cleveland district. Where is Ripon? Which county has the best scenery? Where are chemicals manufactured? What are the Downs? What peninsula is in Yorkshire? Where is the Lake District? What town is on the Ribble? Where is leather tanned? Name a town in the Isle of Wight. Where are the Potteries? Name a town at the mouth of the Tyne. Where are shawls made?—carpets? Where is the 'Black country?' Where are blankets made? What is the most beautiful river in England? Where are hops grown? Where is glass made? &c.

STANDARD IV.

The following are specimens of the cards in *Arithmetic*:—

A. (1) Reduce 175013 drams to cwts., &c.
(2) Divide £158,014 9s. 8d. by 79.
(3) A dealer bought 30 sheep for 75 guineas and sold them for £90. Find the gain on each sheep.
(4) What does a workman get in a year working 313 days at 3s. 6d. a day?

B. (1) £73 15s. 8¾d. × 580.
(2) £298,162 13s. 7½d. ÷ 578.
(3) How many ounce packets of tea could be made out of 5 cwt. 11 lbs.?
(4) If a man buy 16,500 marbles at 30 for a penny, and sell them at five dozen for 3d., how much does he gain?

Answers:—*A.* (1) 6 cwt. 11 lbs. 10 ozs. 5 dwts.; (2) £2,000 3s. 8d.; (3) 7s. 6d.; (4) £54 15s. 6d.
B. (1) £42,796 2s. 11d.; (2) £515 17s. 0½d. + 170; (3) 9136; (4) £1 2s. 11d.

Mental Arithmetic Questions:—

How many threepenny loaves for £1?
How many lbs. in a cwt.?—in ¼ cwt.?—in a stone? How many stones in a cwt.? How many 5s. in £5? &c.

The exercise in *Writing* was dictated from Nelson's New Royal Reader, No. IV.:—

'Obey your parents in all things: The proper spirit of obedience is shown when a child complies at once with the wishes of his parents. It does not allow him to stop and argue the point with them, or to set up his own will in opposition to that of his parents. Their duty is to obey without questioning. Children are not always able to see the reason of their parents' requirements. But that does not excuse disobedience.'

Grammar was tested by oral parsing of the sentence —'A pleasanter sight you never saw.' Many questions were asked about each word; and boys were asked to make fresh sentences illustrating the use of the words.

Questions in *Geography*:—

Name the provinces of Ireland. Where is Ulster? What province is west of the Shannon? Name some rivers in Ulster. What lake is connected with the Bann? Name a town on the Foyle. What happened at Londonderry? In whose reign was the siege? Name some rivers flowing east. Name a town on the Boyne. What are the manufactures of Dublin and Belfast? Where are the mountains of Ireland. Name the ranges.

What river is nearest to Edinburgh? and what town? Name some seaports on the east of Scotland. What are the manufactures of Dundee? Name the largest town in Scotland. Where is it? What kind of ships are built there? Where is Paisley?

Name the provinces of North America. Name some mountains in West Province. Name rivers in British Columbia. River flowing north—lakes connected with it. Where is Manitoba? What are the productions of Canada? What rivers run into Hudson Bay? What class of emigrants are required in Canada? &c.

STANDARD V.

Test cards in *Arithmetic*:—

A. (1) Find the cost of 389 at £3 8s. 9d.

(2) Add $\frac{2}{3}$ and $\frac{1}{9}$, and from the sum take $\frac{3}{4}$.

(3) How many benches, each 15 ft. long, would be required for a school of 189 children, if each child required 1 ft. 8 in.?

(4) Make a bill for—

500 yds. tape, at 9d. per score yds.
17 yds. calico, at $3\frac{3}{4}$d. per yd.
$9\frac{1}{2}$ yds. cloth, at 3s. 5d. per yd.
168 thimbles, at 3s. 6d. per dozen.

B. (1) From the sum of $\frac{1}{6}$ and $\frac{2}{3}$ take $\frac{1}{8}$.

(2) A bill:

112 lbs. at $4\frac{1}{2}$d. per lb.
1 cwt. at 15s. per ton.
60 cwt. at 1s. 3d. per cwt.
10 sacks at 1s. 8d. each.

(3) 53 a. 1 r. 36 poles at £1 13s. 4d. per acre.

(4) If 2 tons 7 cwt. 2 qrs. cost £1 11s. 8d. how many could be bought for £1 15s. 10d.?

Answers:—*A*. (1) £1,337 3s. 9d.; (2) $\frac{1}{36}$; (3) 21; (4) 18s. 9d. + 5s. $3\frac{3}{4}$d. + £1 12s. $5\frac{1}{2}$d. + £2 9s. = £5 5s. $6\frac{1}{2}$d.

B. (1) $\frac{19}{36}$; (2) £2 2s. + 9d. + £3 15s. + 16s. 8d. = £6 14s. 5d.; (3) £89 2s. 6d.; (4) 2 tons 13 cwt. 3 qrs.

For the *Writing* exercise one-half of the boys in this Standard had to reproduce a story, and the other half had to write the following passage from dictation:

'It is as necessary to an English statesman in the East that he should be able to write, as it is to a minister in this country that he should be able to speak. It is chiefly by the oratory of a public man here that the nation judges of his powers. It is from the letters and reports of a public man in India that the dispensers of patronage form their estimate of him. In each case the talent which receives peculiar encouragement is developed.'

This Standard was also divided into two parts for the examination in class subjects, one half taking grammar, and the other half geography. The questions in *Geography* were chiefly on Spain, France, and Turkey.

The exercise in *Grammar* was to parse and analyse one of the following sentences:—

A. On mountain summits melts the snow.

B. Wherefore the blush he vainly tries to hide.

Questions were also asked on the formation of words, and the boys were required to make sentences to show their use.

In Stage I. of *Algebra* the following sets of questions were given:—

A. (1) When $a = 3$, $b = 4$, $c = 0$, find the value of $a - [2b + \{3c - 3a - (a - b)\} + \{2a - (b + c)\}]$.

(2) Add $y + \frac{1}{2}z - \frac{1}{3}x$, $z + \frac{1}{2}x - \frac{1}{3}y$, $x + \frac{1}{2}y - \frac{1}{3}z$, and from the sum take $\frac{1}{6}x - y - \frac{1}{3}z$.

(3) Square $3 - 5x + 2x^2$.

(4) Divide $a^4 - b^4$ by $a + b$.

(5) Write down the elementary factors of $a^4 - y^4$, and $ab - ax - bx + x^2$.

B. (1) If $a = 10$, $b = 20$, $c = 30$, find the numerical value of

$$\frac{a^3 + b^3 + c^3}{abc} + \frac{a^2 + b^2 + c^2}{a + b + c + 10}$$

(2) Find the product of $(7x + 1)(5x + 3)(7x - 1)(5x - 3)$.

(3) Divide $x^5 - y^5$ by $x - y$.

(4) Find the elementary factors of $x^2 - 19x + 90$ and $x^2 - ax + 5x - 5a$.

(5) There are $x + y$ rows of trees in a plantation, and $x + y$ trees in each row; if $2xy$ trees are cut down how many are there left?

Answers:—*A*. (1) 9; (2) $x + \frac{13}{6}y + \frac{2}{3}z$; (3) $9 - 30x + 37x^2 - 20x^3 + 4x^4$; (4) $a^3 - a^2b + ab^2 - b^3$; (5) $(a^2 + y^2)(a + y)(a - y)$; $(a - x)(b - x)$.

B. (1) 26; (2) $1225x^4 - 466x^2 + 9$; (3) $x^4 + x^3y + x^2y^2 + xy^3 + y^4$; (4) $(x - 9)(x - 10)$; $(x + 5)(x - a)$; (5) $x^2 + y^2$.

STANDARD VI.

Arithmetical Cards:—

A. (1) If 18 boys can earn £16 in 17 days, what can they earn in $\frac{2}{3}$ of a day?

(2) Find the simple interest on £650 for $3\frac{1}{4}$ years at 5 per cent. per annum.

(3) Multiply £51 17s. $8\frac{1}{2}$d. by $3\frac{5}{17}$.

(4) Simplify 17·45 days + 4·375 minutes − 2·325 hours.

B. (1) A gentleman left $\frac{1}{3}$ of his fortune to one of his sons, $\frac{1}{6}$ to another, $\frac{1}{4}$ to another, and the remainder, which was £1,545, to his wife: What was his fortune?

(2) Find the simple interest on £350 for 21 months at $3\frac{1}{2}$ per cent. per annum.

(3) Subtract 7·50432 from 31·8777335 and add to the result 8·058634.

(4) If one mile of railway cost £5316 12s. 7d. and the total cost is £251,210 14s. 6¾d., find the length of the railway.

Answers:—*A.* (1) 12s. 6$\frac{10}{17}$d.; (2) £105 12s. 6d.; (3) £164 18s. 4d.; (4) 17 dys. 8 hrs. 32·875 min.

B. (1) £3,150; (2) £21 8s. 9d.; (3) 32·4320475; (4) 47¼ mls.

STANDARD VII.

Arithmetical Cards:—

A. (1) A broker buys 120 lbs. of cotton at 6$\frac{7}{8}$d. per lb., 180 lbs. at 6$\frac{5}{8}$d. per lb., and 240 lbs. at 6½d. per lb. Find the average price per lb.

(2) The insurance on a ship amounts to £1907 10s., which is at the rate of 17½ per cent. Find the value of the ship.

(3) Simplify (·00235 × 3·75) ÷ (·000235 × 37·5).

(4) If 21 men working 11 hours a day can reap 175 acres in 8 days, how many men working 10 hours a day will reap 250 acres in 12 days?

B. (1) A man on an average earned 1½ guineas per week for 11 weeks. He earned £1 15s. per week for 5 weeks, and nothing for 2 weeks; what were his average weekly earnings for the remainder of the time?

(2) If the expenses of 7 persons for 6 days be £17·5875, how much will they be for 5 persons for 2$\frac{3}{7}$ weeks?

(3) If gas shares, which cost £350, are sold for £411 5s., what is the gain per cent.?

(4) A and B divided a certain sum of money between them. A got $\frac{641}{1100}$ of it, and his share was £4 11s. more than B's. How much was the whole sum?

Answers:—*A.* (1) 6$\frac{5}{8}$d; (2) £10,900; (3) 1; (4) 22 men.

B. (1) £2 2s. 10½d.; (2) £33 10s.; (3) 17½ per cent.; (4) £27 10s.

The subjects given for Composition in Standards VI. and VII. were—

A. Outdoor games in winter.

B. Thoroughness in work.

C. Modes of travelling now as compared with former times.

The exercise in Grammar for the same Standards was to parse and analyse one of these sentences:—

A. Around my rustic porch shall spring
Each fragrant flower that drinks the dew.

B. He never fails who dies in a good cause.

Questions were asked on the prefixes.

The boys were required to give the meaning of several prefixes, to give examples, and then to make sentences containing the examples. This was in Standard VI.

In Standard VII. similar questions were asked on the affixes.

In *Geography* the two Standards were taken together, and the examination was oral. Questions were put on the causes that determine climate, on the overland route to India, on Egypt, India, China, &c.

The following set of questions was given to the boys presented in Stage II., *Algebra*:—

(1) Find the G. C. M. of $6ab + 4ab^2 - 2b^3$ and $8a^3 + 4a^2b - 4ab^2$.

(2) Divide $(a^2 - bc)^3 + 8b^3c^3$ by $a^2 + bc$.

(3) Find the value of x in the equation

$$\frac{x}{12} - 3(x - 5) + \frac{x - 10}{4} = 2.$$

(4) I bought 20 books for £10 5s., part of them cost 12s. each, and the remainder 5s. each. How many of each sort were there?

(5) Resolve into factors $(px + qx - ps - qs)$.

Answers:—(1) $2(a + b)$; (2) $a^4 - 4a^2bc + 7b^2c^2$; (3) $3\frac{1}{5}$; (4) 15 at 12s., 5 at 5s.; (5) $(p + q)(x - s)$.

Model Essays for Pupil Teachers.

BY C. J. DAWSON, B.A.,

Ex-President of the N.U.E.T.

II.

IN our introductory paper on Essay Writing last month we gave a few general suggestions followed by a specimen essay. Its subject 'The Writing of Essays' was chosen not because it was a likely one to be prescribed in any examination, but rather because it would afford a means of giving further information and useful hints on the composition of essays, and also form an illustration of the manner in which our suggestions might be carried out. There are one or two points on which it may be well to return to that specimen essay for the purpose of giving further help to our students. First as to the question of length. It was pointed out that essays differ greatly in this respect. The one given was probably longer than could be written in the time usually available for the purpose at an examination, unless indeed the candidate were in full sympathy with his subject, and also a very rapid writer. An essayist however does not as a rule pretend to exhaustive treatment of his subject. The length of an essay must depend on various circumstances,—the conditions under which it is written,—the knowledge of the writer,—the object he has in view. The essay given last month might have closed with the definition deduced from a consideration of the various kinds of essays and their general characteristics. Or a shorter and simpler essay might have consisted of the last two paragraphs with a sentence of introduction explaining briefly the accepted meaning of essay.

Another suggestion contained in the essay was that however limited the time at the disposal of the essayist it would be wise to spend a part of it in making an *outline* of his essay. This plan will help him to duly apportion his time and space to the various points he wishes to deal with, and at the same time to preserve the unity of his composition. We return to this matter in order to urge upon the student that he should not allow the plan or framework of his essay to obtrude itself on the reader. If we look at a fine specimen of a horse we are attracted by its sleek and glossy coat, its rounded contours. These effectually conceal its skeleton from which however it derives its general

form and strength. In an exquisite picture the beautiful effect of combinations of form and colour, though it depends on a judicious plan of applying technical rules, makes no definite suggestion of these to the beholder. 'The highest art is to conceal art.' So, however desultory may be the thoughts in an essay, that which will charm is the smoothness and continuity with which it proceeds from point to point, while it is to the well-planned and underlying outline that the firmness and cohesion of the whole is due.

One other remark we would make with reference to the outline or plan of an essay. Its purpose is to assist the writer not to fetter him. Where he has made his own outline, he should not hesitate to modify it, if, in the course of writing, he finds it desirable to make modifications. It would be contrary to the true purpose of essay writing, if the writer were to regard himself as slavishly bound by rigid adherence to an imperfect plan, and so check the free expression of his better thoughts.

Let us now proceed to our second specimen essay. A very common form in which a subject is prescribed is a familiar proverb, or a quotation from some well-known writer. As an example of the former the reader is referred to an essay on the proverb 'Little strokes fell great oaks,' which appears in the January number of the 'Practical Teacher,' Vol. VII., pp. 512-13. The latter may be very fitly illustrated by an alternative subject given at the same time in the recent examination for teachers' certificates:

'Writing Maketh an Exact Man.'

Among those wonderful short essays into which Lord Bacon packed so much meaning and practical common sense there is perhaps not one more remarkable for its condensed expression of thought than the familiar one which bears the title,—'Of Studies.' And among its most pregnant passages must be reckoned that in which the author compares the respective advantages of reading, conversation, and writing, as aids to the student. 'Reading maketh a full man, conference a ready man, writing an exact man.'

It is important to remember that this passage occurs in an essay on *study*, for knowledge of the context of a quotation often affords the best means of arriving at the proper meaning which the author intended it to bear, just as the real intention of an action can be more truly understood by knowing the circumstances under which it was performed. We infer then that Lord Bacon meant by this passage that the practice of writing helps a man to become an accurate student. He goes on to say 'therefore, if a man write little, he had need have a great memory.' From this it appears that writing is helpful to a student by compensating in some degree for defects of memory, or perhaps we should rather say that the practice of writing tends to ensure accuracy by making a defective memory more retentive.

If we would ask the question 'is the saying a true one?' we might regard these facts a sufficient answer,—that the author was a thorough student himself, that he doubtless spoke from personal experience, that he was remarkable for his habitual practice of carefully recording the results of observation and reading.

We may, however, discover a more satisfactory answer still, if we consider the reason of the matter. Now the accuracy and retentiveness of the memory depend on the clearness and strength of the impression a statement or circumstance makes on the mind. In reading, such impression is made through the sense of sight; in listening to a speaker or reader the impression is made through the sense of hearing; but if the act of writing be introduced the impression must be intensified, for not only does the eye see, or the ear hear, but the elements of the thought or statement must be to some extent assimilated by the brain, before they are translated into the muscular actions which guide and control the pen of the writer. In this way, we cannot doubt the attention becomes more complete, and the remembrance of what is written more accurate and lasting.

If anyone should deem the authority of a great example, and a piece of philosophical argument, insufficient warrant for accepting our text as a true maxim, he can apply the test of practical experiment. Let him listen to a lecture, and take notes on it; or let him study a book and make a summary as he proceeds; or make a record of events and mental impressions; and he will assuredly find his knowledge of these various things more vivid and exact. He will find possibly with surprise how vague and indefinite his impressions are when he first attempts to write them down. With continued practice he will discover how thoughts and observations which are at first hazy and nebulous are condensed and crystallised into substantial existence by the very act of writing.

It is needless to give further suggestions of the way in which the student may avail himself of the help which the practice of writing affords. But it may be well to give one caution. Writing, wisely, thoughtfully, applied, may be of the greatest service; but it will be a great mistake to act as if writing could be regarded as a substitute for exercise of memory. It will be useless to make notes of books, or lectures, or personal observations, and then put them away with the thought that now they are written down there is no need for any effort of memory. Writing is a true aid to study not when it is regarded as a crutch or a go-cart to enable the mind to dispense with effort, but when it strengthens mental effort and makes it more effective.

(To be continued.)

—o—

The London School Board and the Copy Book Question.

At the meeting of the School Board for London on Thursday, the 8th March, 1888, a debate was raised on the recent decision of the School Management Committee to take steps for the production of a series of head-lined copy books for use in Board Schools.

Mr. Heller moved, 'That it be an instruction to the School Management Committee to take no action on the following Resolution of the Committee of the 11th November, 1887:—

"That it be referred to the Books and Apparatus Sub-Committee to prepare, in conjunction with the Board Inspectors, a complete scheme for the production of a series of Head-lined Copy Books for use in the Schools of the Board; and that the Books and Apparatus Sub-Committee be authorised to take the necessary steps for their production."'

Mr. HELLER briefly recited the history of the case to the effect that, in November last, a small Sub-Committee presented to the School Management Committee a report which recommended that certain sets of copy books should be prepared. The latter committee considered the question, and, although very considerable objection was taken, decided not to send up a recommendation to the Board, but, on their own authority, undertook an entirely new departure in the direction of becoming the publishers of their own school books. Although Mr. Heller, at the time, took exception to this course of action, the committee considered that they possessed the power to make such a departure without bringing the matter before the Board. According to Mr. Heller's view, the general arguments against the Board undertaking this work were unanswerable. He was very much surprised to find that this recommendation should come from those who, in the last Board, and, he believed, in the present Board, had, very properly as he thought, gone against the practice of close competition in everything that related to contracts; but now it was proposed to go even beyond that: there was to be no competition whatever. It was a most unadvisable thing for the Board to undertake the duties of a trading or a producing corporation, and there was at least one case in which the courts had held that a public body constituted by statutory powers could not undertake duties of the nature suggested; and, besides, it would be a serious interference with that open competition and enterprise which had marked school books in recent years. The books at present within reach were infinitely better than those of any previous period, and there was a far greater variety, though it must be admitted that there was a great deal of rubbish in the market. There was only one instance in which a public body had tried the experiment of publishing their own books; and that body was the Commissioners of National Education in Ireland: but they were now retracing their steps. The experiment had killed all chance of competition, and the result was that the schools in Ireland had been, for two or three generations, limited to books which were entirely out of date, with little or no choice. It had been said that the only ground on which the present proposal was made was that of economy, but he (the speaker) did not believe that the Board, even under the admirable business arrangements which some of their members had introduced, would be able to produce the books as cheaply as others in the ordinary course of business. In making inquiries into the matter, he had found that the price of one particular specimen of paper submitted to the committee (and which he then had before him) was high, having regard to its quality and weight; which fact showed, on the very threshold, that the committee could not produce books of the quality and at the price which had been produced in the past. He asked if any expenditure in connection with the matter had yet been incurred.

The CHAIRMAN of the Board replied in the negative.

Colonel PRENDERGAST asked whether Mr. Heller meant to assert that the Board were about to undertake the position of publishers proper.

Mr. HELLER replied that he meant to assert that, where the Board had to supply their own schools, they were undertaking, in the strictest sense of the word, the production of books.

Mr. LOBB seconded the motion on the ground that it would be a great injustice to the trade generally. No one could shut his eyes to the fact that the provincial School Boards would follow the example of the London Board, for the former copied the latter in almost everything. One could imagine the feeling in the trade amongst firms who had laid themselves out for the production of copy books for the last quarter of a century, when they knew that their business would slip out of their hands. It would be a great hardship to teachers to confine them to one uniform set of copy books. It would also inflict a great hardship upon some of those members of the Board who, like himself, gave a large portion of their time to the commercial part of the Board's work. He thought that the results of the Store ought to be a warning to the Board not to extend their commercial operations. There might be, on the next Board, two or three ladies who would insist on managing the Store again; and it could not be guaranteed that those ladies would have the capacity for business necessary for the work; neither could it be guaranteed that the Board would have a gentleman with the business capacity and knowledge of the work that the present Chairman of the Board had. Mr. Lobb counselled the Board not to accept the School Management Committee's proposal, which would only create further troubles. He (the speaker) then referred to the trouble which he had experienced during the past five years—hard work, worry, loss of time, misinterpretations, &c., and concluded by declaring his belief that economy had had nothing whatever to do with the decision of the School Management Committee in this case.

Mr. RUSSELL ENDEAN pointed out that, if the Board had had no choice in the matter of head lined copy books, then there would be some reason for the present proposal; but, so far from this being the case, they could select out of the vast number of copy books prepared by distinct and independent publishers such as might be found suitable and appropriate for use in the Board Schools. The Board had the choice of the best styles of writing that could be produced, and the publishers, knowing their own interests better than the Board did, produced the best styles for the acceptance of the Board. If the Board were to pursue the course suggested, they would provoke great dissatisfaction out of doors, and produce in the end a calamitous state of things similar to that in the Store Department, from which the Board had only just been able to extricate themselves. He urged the Board to support Mr. Heller's motion.

Colonel HUGHES, M.P., said that the School Management Committee proposed to produce a copy book which they considered most suitable. After the experience which the Board had had, they must have found some points in copy books which commended themselves more than others; and, with regard to the production of copy books of the most suitable kind (and by production, he understood, was meant the advertising for tenders), the Board would obtain the requisite quantities by public competition. Those who tendered would be bound by such tenders, but he (the speaker) would like the School Management Committee to come to the Board with a form of tender and an estimate of the number of copy books required, and then the necessary authority could be given for the tendering to take place. The Board were not going to undertake the duty of publishers. If a good copy book were produced, let every School Board in the country have the opportunity of adopting it; the Board did not want to play the dog in the manger about it.

Mr. GOVER wanted to know where the Board were going to stop; if the principle were applied to copy books, why not apply it to other things. He contended that there was no end to improvement. If he thought that this Board, or the Sub-Committee, or the School Management Committee were the wisest people in the world, now, and ever would be, then, perhaps, he might be disposed to agree and to think their course of action wise, but he was satisfied that they were not so. He objected to teachers having their choice limited in the way proposed, and could see no advantage to be derived from it, even if the Board selected the best kind of copy book.

The Rev. J. J. COXHEAD was not surprised at the vigorous opposition to the proposal of the School Management Committee, which, no doubt, was, to a certain extent, dictated by interested persons outside the Board. The Board were prepared, he believed, within certain limits, to trust the School Management Committee, and, without looking deeply into the question themselves, would be prepared, where the committee made a recommendation of this kind, to adopt it, but, of course, those who supported it must meet the objections made to it. One

objection made was that the plan would not be economical, but the answer to that was that, as every copy book bought under the present system must pay a certain profit to the compilers, obviously it must be more economical for the Board to prepare their own copy book than to take one from outside. Mr. Coxhead was not satisfied with the headings of the copy books now in the hands of the children, nor was he satisfied with the school books, and he believed that the Board would be adopting a course very much in the interest of education if they placed in the hands of the School Management Committee such a power as would enable them to prepare what would be considered a satisfactory copy book, which, however, would only take its place amongst the copy books published by other firms. These remarks would apply as much to reading books as to copy books, and, until a satisfactory reading book should be prepared, the Board were losing one great instrument in the education of children. The reading books were not satisfactory either in respect of the technical education of the children, the education of their emotions, or their scientific education; and if the present Board did not take up the question, he (Mr. Coxhead) hoped that some future Board would do so in a most serious manner. Considering that there was on the Board a fund of technical and special knowledge, something ought to be done in this direction for the benefit of the schools.

Mr. STONELAKE argued that, if, as Mr. Coxhead said, the publishers made a profit which the Board would not require to make, therefore the Board would save money, but many people began business with the hope of making a very good thing out of it but often came to a very bad ending. Any loss made by the Board would have to be borne by the ratepayers at large. If the plan were to be adopted with regard to copy books, why not extend it to slates, printing, coal, and other things; indeed, why not buy a coal mine and manage it? The Board, before extending their operations, should remember their past experience with regard to the store, and how lamentably they failed in their shopkeeping arrangements. He (the speaker) would like to sweep the store away altogether for the reason (if for no other) that the Board were not established for shopkeeping, but for the education of the children of the metropolis. The proposal, if adopted, would be a restriction of choice, for having chosen one particular set of books, the Board could not, without great expense, throw that aside and take another. The Board had the opportunity, under the present system, of making the best possible terms with the best publishers, because it was well known that payment was sure. Mr. Stonelake urged the Board to stick to the work for which they were elected, and not to try to take the bread from other people.

Mr. MARK WILKS stated that he voted for the proposal in the committee, though he had some hesitation at the time in doing so, but he had been quite convinced since that the step would be a false one, and, if he had wanted further conviction, it had come from Mr. Coxhead in his speech. He was convinced that the variety insisted upon by Mr. Heller was essential. It was said in the School Management Committee that copper plates were to be prepared, the plates being the property of the Board, and that copies were to be printed off by the Board's printers. Mr. Wilks declared that he would now vote for Mr. Heller's motion, his former vote in the committee having been given before he knew so much about the question.

Mr. BARNES, like Mr. Wilks, had voted for the proposal in the committee, and, like him, too, he should now vote against it. It was shown in the committee that there was an immense saving through the Board having their own registers, and it was argued that there would be a great saving if the Board were to produce their own copy books. But there was a broad line to be drawn between registers and ordinary school books. While Mr. Barnes strongly objected to the Board becoming publishers, he had an idea that copy books came under a different category, and were very closely allied to registers, but, on looking through the books on the requisition list he found 27 different sorts of copy books which could be classified under three or four different kinds of writing. The inspectors had been asked to go through the different sets of books now in use, and to pick out from them all the good points, in order that they might be embodied in one superior set for the use of the Board, and be put out to contract for the production of the requisite number. That might be very well for a tradesman to do, but he (the speaker) did not think it was a fair or proper thing for the Board to pick the brains of the publishers in order to produce copy books, and then to compete against them. He was not quite sure about the economy of the thing, and, besides that, the whole of the publishing trade was against them.

Professor GLADSTONE, F.R.S., having attended all the meetings at which the question was considered and having read all that had been written on the subject, was of opinion that there were advantages and disadvantages in the proposal, and, so far as he was concerned, he would not care very much whether the proposal were carried or not. He would explain how the case had originated, for there was a good deal of history that had not come out. The Books Sub-Committee had the subject of copy books before them, and a Special Sub-Committee was appointed to look into it. Professor Gladstone stated his belief that the subject of copy books was the cause of the formation of the store in the first instance. Recently there had been a great demand in the Board Schools for the Graphic Copy Book, and, judging from its merits, it ought to be on the Board's list, but it was published by a Company consisting of a large number of Teachers who hold shares of £10 each, there being few teachers who hold many shares, and it was said that this matter was being pushed in a way of which the Board could not approve; and other books might be brought forward in the same way. The same rule might be applied to teachers that was applied to the Board Inspectors, viz., that no books in which they had an interest should be put upon the requisition list. The Board were cutting the Gordian knot by refusing to accept any copy book and producing a copy book of their own. The proposed course of action, after a very able discussion, was carried in the School Management Committee, though the majority was not a large one; then followed an outcry from the publishers and some members of the Board. It was assumed by the publishers that the Board were going to publish, but there was no intention of that kind, the Board would only produce books for their own schools. Then it was stated that there would be only one set and that the power of choice would be taken from the teachers. But there was no intention of having only one set or one kind of head lines. There was no reason to confine the teachers to the Board's books, any other books that the Board chose might be added to the list; all that was proposed was that the Board should produce their copy and exercise books with headlines. It was said that the Board were interfering with the profits of publishers, but one publisher had said that that was not so for publishers' profits were so small as to be hardly worth talking about. Professor Gladstone could not see that any injustice would be done because the Board had never made any arrangement with any publisher for producing copy books. Then there was the educational argument that the Board were stereotyping a style, and the speaker announced that he had more sympathy with that argument than with any other, for he would be opposed to having only one style of copy book. Some members had brought forward the old calumnies about the store, but it should be known that copy books cost the Board £50 a week, and if there were any saving of any percentage, it would come to a large sum in a year. The Board ought not to fetter their teachers in the choice of variety, and this would be easily avoided by allowing the Board's copy books to come into circulation in their schools amongst other copy books. Professor Gladstone concluded by expressing himself indifferent as to whether Mr. Heller's motion were carried or not, and, for that reason, he would not be disposed to support it.

Mr. LYNN remarked that, if this were a discussion as to the merits of any particular set of copy books, he did not think it would be worth while for the Board to consider it, for in a matter of that kind the School Management Committee should have free hands. The production of the copy books was thoroughly understood by the Committee to mean their preparation at the Board's expense; there had been no suggestion of tenders for their supply, and if the proposition were what Colonel Hughes thought it was, he (the speaker), for one, would not oppose it. Mr. Coxhead had put another colour, which Mr. Lynn believed to be a false one, upon the proposition, viz., that the School Management meant to have one set of copy books; but, when that was found to be weak, it was said that the Board could have more than one set; now Mr. Coxhead said that it was not intended to produce copy books in competition with others. Mr. Lynn, however, contended that the School Management Committee did intend to publish the copy books. The present practice was that when those in the trade and those who made themselves specialists in school material had undertaken the expense and preparation of any article, the article, when produced, was submitted to, and examined by, the Board through their School Management Committee, who selected such articles as were good, and allowed them to be used in the schools. If the School Management Committee were to try, as a Committee, to satisfy Mr. Coxhead, a great amount of diversity would be found. The Members of the Board were not skilled in copy book preparation, which would have to be left to the Board Inspectors, who, probably, had had no experience in the matter. Some members thought the preparation meant only writing down twenty-four sentences in a bad handwriting and leaving the publisher to make it good, but he (the speaker) knew from his own experience that it was a very different matter indeed. The expense would be very considerable, more especially when it was considered that the only area of distribution was the Board Schools; and, if four sets of books were provided, the expense would be increased. When a publisher prepared a set of books he did so to compete through the length and breadth of the land, but, if the Board themselves published, they cut off one of his best customers; though the profit to the publisher by the Board's custom was nothing comparable with the initial expense of the plates, which expense was spread over the whole country. If Dr. Gladstone were to appeal to the printers of the copy books (persons who had nothing to do with the preparation of the books themselves), he would find that the amount charged by them would differ very little from that which would be charged by the publishers, on account of the competition. Besides, the Committee's line of action would tend to force on teachers a uniform style of writing. One teacher had stated to the speaker that he did not use any copy books in his school lower than the Third Standard, the boys up to that stage being taught by means of the blackboard, according to a style of his own, and then he selected from the list those books which were best suited to his wants. If any member would take the trouble to look through the sixty or seventy copy books on the list, and were to put on the backs the dates when they were published, he would find that the books improved by the lapse of years, for the reason that, in the production of copy books, as in everything else, there had been constant improvement—improvement in engraving, machinery, style of writing, and so forth. If the Board endorsed the plan of their Committee, there would be enormous difficulty in inducing any future Board to lay aside their stock for producing books in order to adopt any improvement.

The Rev. C. E. BROOKE rose in consequence of the speech of Dr. Gladstone, from whom he gathered that the whole system of the Board was to be revolutionised in consequence of the Board's fear of getting into the hands of certain teachers whose names were unknown, and protested against such an idea as being monstrous. If the Board were going to have no dealings with any society in which a teacher might be a shareholder, he did not know where the Board would land themselves. He considered that the objections against the proposal of the Board having their own copy books were unanswered and unanswerable. Though he (Mr. Brooke) was looked upon by his tory friends as a radical, and by his radical friends as a tory, he was as much a free trader in copy books as in anything else.

Mr. HELBY said that if there had been any idea of the Board becoming publishers, he would not have agreed to the proposal in committee. If the Board sanctioned the committee's plan, it meant that certain styles of writing would be approved. Having referred generally to the various styles of writing in the schools, Mr. Helby stated that a large number of teachers, who seemed to prefer the Civil Service style, had asked for what were known as the Graphic Copy Books to be supplied to them. He then went on to explain that, when the proposed headlined copy books should have been prepared, tenders would be obtained in the usual way; which, he argued, could not be called publishing. Such a course would give the Board the opportunity of getting the best articles at the lowest cost, and would, further, secure a uniform quality of paper, which, at the present time, was by no means the case. It was a well known fact that, not only with copy books, but with reading books and all other things, it was not the best book but the best touter in the schools that won.

The Rev. A. A. W. DREW expressed his surprise at Mr. Helby taking the line of argument which he did, because Mr. Helby had always, prior to the present case, advocated the system of open tendering.

After a reply from Mr. Heller, a division was taken on his motion, which resulted as follows:—For, 20; against, 15. The motion was therefore carried.

Mr. HELLER then moved, and Mr. LOBB seconded, 'That, in the opinion of the Board, it is inexpedient for the Board to undertake the duties of publishers; and that it be an instruction to each Committee not to adopt any course involving new principles of action or new expenditure except under the authority of the Board; but, after a short discussion, the motion was withdrawn.

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Pupil Teacher Examination Papers (Scotland).

28TH JANUARY, 1888.

END OF THIRD YEAR.

FIRST PAPER.

(*Two hours and a half allowed for this Paper.*)

Dictation.

Write from dictation, in a neat hand, with correct spelling and punctuation, the passage read by the Inspector.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word 'Majestically.'

Write in small hand, as a specimen of copy-setting, the sentence 'Wearing the white flower of a blameless life.'

Arithmetic.

MALES.

1. A can give B 100 yards' start in a thousand yards; B can give C the same start in the same distance. How many yards' start can A give C in a thousand?

A's walking = $\frac{1000}{900}$ or $\frac{10}{9}$ of B's

Similarly B's = $\frac{10}{9}$ of C's

$\therefore$ A's = $\frac{10}{9} \times \frac{10}{9} = \frac{100}{81}$ of C's

that is while A does 1000, C does $\frac{81}{100}$ of 1000, or 810 yards for A's 1000

$\therefore$ A can give C a start of 190 yards. Ans.

2. A man transfers £5000 from the Three per Cents. at 75, and buys 4 per cent. debentures at par. What is the difference in his income?

(*a*) By selling the £5000 at 75 he realizes $\frac{£5000 \times 75}{100} = £3750$

(*b*) £3750 will purchase just that sum in the debentures at par.

$$\text{1st income} = \frac{£5000 \times 3}{100} = £150$$

$$\text{2nd income} = \frac{£3750 \times 4}{100} = £150$$

$\therefore$ There is no change in his income.

FEMALES.

1. Write in decimal notation 5 hundredths, 5 hundreds, 5 millionths; add them together and multiply their sum by ·001.

(*a*)

5 hundredths	=	·05
5 hundreds	=	500·
5 millionths	=	·000005
Their sum	=	500·050005

(*b*) 500·050005 × ·001 = ·500050005. Ans.

2. Reduce 2·083 of £16 16s. to the decimal of £21

$$\frac{£16{\cdot}8 \times 2{\cdot}083}{£21} = {\cdot}8 \times 2{\cdot}083$$

$$= 1{\cdot}6664. \text{ Ans.}$$

3. Whether will the fraction $\frac{11}{24}$, when converted, produce a terminating or a repeating decimal fraction.

$\frac{11}{24}$ will produce a repeating decimal because its denominator, 24, when reduced to its prime factors = 2 × 2 × 2 × 3

11 not being a multiple of 3, there will be a remainder, and hence the decimal will repeat.

4. Divide the difference between 1 and ·992748 by ·0074, and prove the truth of your answer by vulgar fractions.

(*a*) 1 − ·992748 = ·007252

(*b*)
$$\begin{array}{r} \cdot0074)\cdot007252(\cdot98 \\ \underline{666} \\ 592 \\ \underline{592} \end{array}$$

(*c*)
$$\cdot007252 \div \cdot0074 = \frac{7252}{1000000} \div \frac{74}{10000}$$
$$= \frac{7252}{1000000} \times \frac{10000}{74}$$
$$= \frac{10000}{1000000} \times \frac{7252}{74}$$
$$= \frac{1}{100} \times 98 = \cdot98.$$

Euclid.

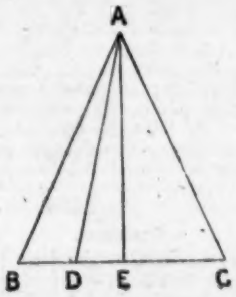
1. If the square described on one of the sides of a triangle be equal to the squares described on the other two sides of it the angle contained by these two sides is a right angle.

Euclid, Bk. I., Prop. 48.

2. If a straight line be divided into two equal parts, and also into two unequal parts, the rectangle contained by the unequal parts, together with the square on the line between the points of section is equal to the square on half the line.

Euclid, Bk. II., Prop. 5.

3. The square on any straight line drawn from the vertex of an isosceles triangle to the base, is less than the square on the side of the triangle, by the rectangle contained by the segments of the base.



Let ABC be an isosceles triangle, having the sides AB, AC equal to one another, then if AD be any straight line drawn from the vertex A to the base BC, the square on AD is less than the square on AB (or AC) by the rectangle BD, DC.

Bisect BC in E. Join AE. AE shall be perp. to BC. Because AB = AC, and AE is common to the two triangles ABE, ACE and the base BE = EC, then (I. 8) the angle BAE = angle CAE; and the other angles are equal to the other angles (I. 4). Hence the angle BEA = the angles CEA, and they are adjacent angles; therefore each of them is a right angle, and therefore AE is perp. to BC.

Again, because BC is cut equally in E and unequally in D, the rect. BD, DC together with the square on DE is equal to the square on BE. To each of these equals add the square on AE. Then the rectangle BD, DC together with the squares on DE and EA is equal to the squares on BE and EA. But the square on AD is equal to the squares on DE and EA (I. 47), and the square on AB is equal to the squares on BE and EA. Therefore the rect. BD, DC together with the square on AD is equal to the square on AB. That is, the square on AD is less than the square on AB (or AC) by the rectangle BD, DC.

Q.E.D.

Algebra.

1. Solve the following equation:—

$$\tfrac{1}{6}(4x-21) + 3\tfrac{3}{4} + \tfrac{1}{4}(57-3x) = 241 - \tfrac{1}{12}(5x-96) - 11x$$

$$\frac{4x-21}{9} + \frac{15}{4} + \frac{57-3x}{4} = 241 - \frac{5x-96}{12} - 11x$$

$$16x - 84 + 135 + 513 - 27x = 8676 - 15x + 288 - 396x$$

$$16x - 27x + 15x + 396x = 8676 + 288 + 84 - 135 - 513$$

$$427x - 27x = 9048 - 648$$

$$400x = 8400$$

$$x = 21. \text{ Ans.}$$

2. Find the greatest common measure of—

$110 - 13x - 2x^2 + x^3$ and $x^4 + 7x^3 + 7x^2 - 15x$

Arranging terms and eliminating x from the 2nd.

$$x^3 - 2x^2 - 13x + 110 \;)\; x^3 + 7x^2 + 7x - 15 \;(\; 1$$
$$x^3 - 2x^2 - 13x + 110$$
$$9x^2 + 20x - 125$$
$$x^3 - 2x^2 - 13x + 110$$
$$9$$
$$9x^2 + 20x - 125 \;)\; 9x^3 - 18x^2 - 117x + 990 \;(\; x - 38$$
$$9x^3 + 20x^2 - 125x$$
$$-38x^2 + 8x + 990$$
$$9$$
$$-342x^2 + 72x + 8910$$
$$-342x^2 - 760x + 4750$$
$$832 \mid 832x + 4160$$
$$x + 5$$

$$x + 5 \;)\; 9x^2 + 20x - 125 \;(\; 9x - 45$$
$$9x^2 + 45x$$
$$-45x - 125$$
$$-45x - 125$$

$\therefore$ $x + 5$ = G. C. M.

Simplify the fraction $\frac{\frac{1}{2}(x+1\frac{1}{2}) - \frac{3}{4}(1-\frac{3}{4}x)}{1\frac{3}{4} - \frac{1}{3}(x+3\frac{1}{4})}$

$$\frac{\frac{1}{2}(x+1\frac{1}{2}) - \frac{3}{4}(1-\frac{3}{4}x)}{1\frac{3}{4} - \frac{1}{3}(x+3\frac{1}{4})} = \frac{\frac{x}{2} + \frac{3}{4} - \frac{3}{4} + \frac{x}{2}}{\frac{7}{4} - \frac{x}{3} - \frac{13}{12}}$$

$$= \frac{x}{\frac{21 - 4x - 13}{12}}$$

$$= \frac{12x}{8 - 4x}$$

$$= \frac{3x}{2 - x} \quad \text{Ans.}$$

Grammar.

'All the remedy *that offered* to my thought at *that* time was to get up into a thick bushy tree *like* a fir, but thorny, which grew near me, and where I resolved to sit all *night*, and *consider* next *day* what death I should die, for as *yet* I saw no prospect of life.'

1. Analyse the above passage.
2. Parse fully the words in italics.

SENTENCES	KIND	CONNECTIVE	SUBJECT	PREDICATE	OBJECT	EXTENSIONS
1. All the remedy was to get up into a thick bushy tree like a fir but thorny	Princ.		All the remedy	was to get up into a tree &c.		
2. that offered to my thought at that time	sub. adj. to 1		that	offered	(itself) to my thought (indirect)	at that time (time)
3. which grew near me	sub. adj. to 1	which	which	grew		near me (place)
4. and where I resolved to sit all night	sub. adj. to 1	and where	I	resolved	to sit all night (completion)	(where) (place)
5. (and where I resolved) to consider next day	sub. adj. to 1	(and where)	(I)	resolved	to consider next day (completion)	where (place)
6. what death I should die	sub. noun to 5		I	should die	what death	
7. for as yet I saw no prospect of life	sub. adv. to 1—6.	for	I	saw	no prospect of life	as yet (time)

PARSING.

That—simple rel. pron., anteced. 'remedy,' 3rd pers., sing., neut., nom., subj. of 'offered.'
offered—reg. trans. (here used intrans.) verb, act., indic., past indef., 3rd pers., sing., agr. with 'that.'
that—demonstr. adj., pointing out 'time.'
like—adj. qual. 'tree' (some call *like* a prep. but it is better to make it an adj. with 'to' understood).
night—abstr. noun, neut., sing., obj. 'of time.'
consider—reg. trans. verb, act., infin., pres., gov. by 'resolved.'
day—abstr. noun, neut., sing., obj., of 'time.'
yet—adv. of time modif. 'saw.'

3. Point out the Latin prefixes in the above passage and indicate their exact force in each case.

LATIN PREFIXES.

ob- in 'offer' means 'against' or 'in the way of.'
re- in 'resolved' means 'again.'
con- in 'consider' means 'together.'
pro- in 'prospect' means 'before.'

SECOND PAPER.

(*Two hours and a half allowed for this Paper.*)

1. Draw a map of India, indicating the chief divisions and mountain ranges.

2. State what you know of Burmah.

A strip on the N.W. of the Malay Peninsula extending from Bengal along the coast to the root of the peninsula was till recently known as British Burmah, but is now under the government of India. It has an area about equal to Great Britain and is divided into the provinces of Aracan, Pegu, and Tenasserim. It is specially valuable for rice and teak. The population has increased rapidly under British rule. British Burmah is the only part of Indo-China in which railways have been introduced, two starting from Rangoon, one for Prome, and the other northward by Pegu. Proposals are now being made for a railway from the Gulf of Siam to the Chinese frontier, with the view of extending commerce with the rich provinces of south-western China.

On January 1, 1886, the former kingdom of Burmah, with Mandalay on the Irawaddy for its capital, was added to the British dominions, so that Britain has now the command of the whole course of the Irawaddy as far as Bhamo. There has been much trouble with the Dacoits for some time.

3. Write short descriptive notes on the following places :—Teheran, Singapore, Suakim, the Zambesi, Port Hamilton, Aleppo, Borneo, and New Guinea.

Teheran, now the capital of Persia, consists of splendid edifices and magnificent gardens intermingled with mud huts. In summer the heat is so great that the Shah and his court encamp out on the plain of Sultania, 150 miles from the city.

Singapore, on a small island at the extremity of the Malay Peninsula, is a British seaport lying on the route from India to Australia and Eastern Asia, and hence it is the most important seat of marine commerce in Indo-China.

Suakim is the only port of Nubia, on an island in the Red Sea; has a good harbour, and is a great place for the embarkation of pilgrims on their way to Mecca. The British made great use of it in the last Egyptian war.

The Zambesi, a large river of South Africa, has numerous head-streams, in a region thickly streaked with rivers partly belonging to its basin and partly to the Congo. After an eastward course, estimated at 1350 miles, through a fruitful and populous country, it falls by several mouths into the channel of Mozambique. About 800 miles from its mouth are the Victoria Falls. Like all the other great African rivers, it periodically overflows its banks.

Port Hamilton. This station of the British Navy consists of three small islands situated about forty miles south of Corea, commanding the straits of that name, which lead from the China Seas to the Japanese Seas. The three enclose a harbour two miles long by a mile broad, and from nine to twelve fathoms deep. As it both commands the straits and forms an available coaling station, Port Hamilton is considered to be of much importance. There was some talk about evacuating Port Hamilton.

Aleppo, or Haleb, a town in Syria, occupies an oasis situated about midway between the Mediterranean and the Euphrates, where that river in its middle course approaches nearest the sea, and has hence been from time immemorial an important trade centre.

Borneo is a large island of the Malay Archipelago, divided into various states. Holland claims slices along the south, east and west of the island. In reality, this immense tract is parcelled out into various native states. Those on the coast are more or less under Dutch influence. Of the interior little is known. On the N.W. coast is Sarawak, under British influence, though not a British dependency, being governed by an English Rajah, Charles J. Brooke, whose philanthropic efforts, and those of his predecessor, have done much to restore the ancient prosperity of the native states. Borneo is considered to be physically one of the most attractive portions of the earth's surface.

New Guinea, close to Australia, on the north, is about three and a third times the size of Great Britain. It is mountainous, has dense forests, haunted by many gay-plumaged birds, and among these the bird of paradise. The natives are Papuans, and are of a very dusky hue. Some are very friendly, others fierce and intractable. The island is shared by the Dutch, Germans, and British. Not much is known of the interior, but exploring expeditions are now at work. Port Moresby is the British official centre.

History.

1. Name the leading Statesman, the leading General, and the leading Admiral, of the reign of George III. Give a brief account of *one* of them.

In the reign of George the Third, William Pitt (the younger) was the leading Statesman, Lord Nelson the leading Admiral, and the Duke of Wellington the leading General.

WELLINGTON.

Lord Wellington (Arthur Wellesley) was the greatest soldier of modern times. Third son of the Earl of Mornington, he was born in Ireland, 1769. After finishing his education at Eton, he entered the army as ensign, and ten years after took part in the war in the Carnatic. In 1803 he gained the great victory of Assaye. Entering Parliament, 1807, he became Secretary for Ireland. Succeeding Sir John Moore in command of the armies in the Peninsula he, by a series of unexampled successes from 1809 to 1813, drove the French out of Spain across the Pyrenees. After attending a Congress of the European Powers at Vienna, he was called upon to take the field against Napoleon, whom he met for the first time at Waterloo, and where he utterly defeated him.

In 1822 he entered on his career as a statesman, became Prime Minister in 1828, and continued to be the trusted adviser of his sovereign till his death in 1852.

2. State the circumstances that led to the American war of Independence, with the name and date of the first battle.

The chief causes of this long and disastrous conflict are to be sought in the stubborn self-will of George III., and in the equally absurd self-conceit of his English subjects.

Grenville, the English Prime Minister, having determined to tax the colonists for the benefit of the empire, adopted the plan of raising the revenue by requiring that certain documents should be on stamped paper.

The colonists at once became alarmed, and declared that 'taxation without representation was tyranny.' So strong was the feeling, that riots took place at Boston and elsewhere; and the colonists determined to do without English goods, so as to escape the hated imposition. All was in vain, for the king and people at home were deaf to their remonstrances; and in 1766, although the Stamp Act was repealed, the English Parliament passed a bill declaring the legislative supremacy of England over her colonies. Shortly afterwards, a new scheme of taxation was introduced, by which the revenue was to be raised by *port duties*, not by internal excise. The feeling on both sides now became more bitter; and when the other duties were removed, that on tea was retained more to mark the superiority of the English Parliament than as a matter of finance.

A circumstance, in itself trifling, brought matters to a crisis. The East India Company had a great stock of tea in its warehouse, and it was allowed to export this to America free of English duties, so that in the colonies it could be sold at a very low price, but the hated colonial duty had still to be paid. Three ships laden with tea arrived in Boston. A band of men, dressed as Mohawk Indians, boarded them and flung the chests into the sea.

When the news reached England the commercial classes wished to bring about reconciliation, but *the King, the governing classes, and the great body of the people*, maintained that the time for conciliation was over, and that America must be subdued.

A congress assembled at Philadelphia professed loyalty to the king, but refused to pay taxes imposed by imperial authority, and entered into a rigid agreement neither to consume British goods nor to export a single product of their own.

At home Lord North proposed that as long as a colonial legislature paid a reasonable sum towards the imperial expenses it should be exempted from all imperial taxation. Had this concession come earlier all would have been well; but it now came too late. Two months later General Gage sent a party to destroy a quantity of stores at *Concord*, but it was attacked and badly treated. The whole population arose, and Gage was shut up in Boston. He then fought and won the battle of Bunker's Hill (1775).

Composition.

Write a letter on 'Parliament' or on 'The best methods of teaching Needlework in a School.'

Glasgow, 28th Jan., 1888.

Sir,

As my experience in teaching needlework has not been wide enough to warrant me in taking upon myself to give the 'best methods' of teaching needlework, yet I shall endeavour to give you the methods of teaching employed by the lady who is responsible for this subject of instruction in our school.

We follow the syllabus as given in Schedule 3, and according to it the Infants are given needle drill as it is called in which we practise them in the best manner of holding wires, wool, how to hold sewing-needles, with the management and use of the thimble. Standards I. and II. can be taken together after a little, as the work of II. is not much in advance of I. In fact we think also that Standard II. might take a little of Standard III. work, and that Standard III. might take the easier stitches of Standard IV., as the leap from III. to IV. is a pretty long one. Every class should have a teacher of its own and if the class is large it should be cut up into sections of twenty or thirty. For darning, marking, and drawing for cutting out, if there be no frames we use the blackboard and find the method very effective—Standards IV. and V. being taught successfully in this manner last year.

Should there not be sufficient teachers to have one at every class, all the Standards are not taken every day. We found this plan to work very well as the Mistress had time to superintend and see what every one was doing, and how she was doing it.

All odd pieces of cloth left from cutting out garments were used by the scholars in learning and practising new stitches. The older girls in helping the younger ones to fold their slips for hemming, &c., got additional practise themselves and confidence in their own work. By utilising the more advanced of the members of the younger Standards had also a beneficial influence on the ambitious ones who felt themselves as it were little mistresses.

Simultaneous teaching was used a good deal and found to be not only a successful method but a good one for economizing time and labour.

I am, Sir,
Your obedient servant,
MARY TEACHER.

H. M. Inspector, Esq.

Latin.

SECOND STAGE.

(*Answers to be written on a separate paper.*)

1. Explain the meaning and use of the gerund and gerundive of a Latin verb, and illustrate by example.

The gerund is a verbal substantive and has four cases, the genitive, dative, accusative, and ablative, and governs the same case as its verb. Its nominative is supplied by the infinitive, and the accusative is used only when governed by a preposition: in all other cases the infinitive supplies the accusative. N. *Scribere difficile est*, writing is difficult. G. *Ars scribendi*, the art of writing; *Puer paratus est ad scribendum*, the boy is ready for writing; *Puer fatigatus est scribendo*, the boy is wearied with writing.

The gerundive is a passive participle generally implying the idea of necessity or possibility, and is the agent by whom the action is to be done in the dative instead of the ablative, with the preposition *a* or *ab*, as: *Pater amandus est*, the father must be loved; *Mihi scribendum est*, I must write; *Bellum mihi gerendum est*, war must be carried on by me.

2. Give a list of adjectives that govern the ablative case.

The following adjectives and participial adjectives govern the ablative:—Dignus, indignus, contentus, fretus, natus, satus, ortus, genitus, editus, creatus, and the like, denoting origin, as dignus honore, worthy of honour.

3. Write out the future and present subjunctive of *eo* and *prosum*.

Future.		Present Subjunctive.	
Sing.	*Plur.*	*Sing.*	*Plur.*
Ibo	ibimus	eam	eamus
Ibis	ibitis	eas	eatis
Ibit	ibunt	eat	eant
Proderim	proderimus	prosim	prosimus
Proderis	proderitis	prosis	prositis
Proderit	proderunt	prosit	prosint

4. Translate, parsing the words in italics.

(*a*) Apollinis templum *omni* argento *spoliavit*.

(*b*) Nihil est *morti* tam simile quam somnus.

TRANSLATION.

(*a*) He plundered the temple of Apollo of all the silver.

(*b*) Nothing is so like death as sleep.

PARSING.

omni—abl., sing., neut., adj. of 3rd decl., *omnis, omnis, omne*, agr. in gen. no. and case with 'argento.'

spoliavit—reg. trans. verb, act., indic., perf. def., 3rd pers. sing., agr. with (ille).

morti—dat., sing., fem., noun of 3rd decl., *mors, mortis*, gov. by the adj. of 'likeness,' 'simile.'

5. Translate into Latin:—

(*a*) Without air and sun animals cannot live.

(*b*) Many praise others that they may be praised by others.

TRANSLATION.

(*a*) Sine aëre et sole animalia vivere non possunt.

(*b*) Multi alios laudant ut ab aliis laudentur.

END OF FOURTH YEAR.

FIRST PAPER.

(*Two hours and a half allowed for this paper.*)

Dictation.

Wirte from dictation, in a neat hand, with correct spelling and punctuation, the passage read by the Inspector.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word 'Majestically.'

Write in small hand, as a specimen of copy-setting, the sentence, 'Wearing the white flower of a blameless life.'

Arithmetic.

MALES.

1. Goods are insured above their real value for £400, at 4½ per cent., so that in case of loss their real value and the premium may be recovered. What is their real value?

£104½ : £400 :: £100 : real value.

$$\frac{£100 \times 400}{104\frac{1}{2}} = \frac{80{,}000}{209} = \underline{£382\ 15s.\ 6\tfrac{8}{209}d.}\quad \text{Ans.}$$

2. A man drawing an income of £870 per annum from three per cent. stock, sells out at a profit of £1,450. What is the selling price of stock?

(*a*) £3 : £870 :: £100 : stock in 3 per cents.

$$\frac{£100 \times 870}{3} = £29{,}000$$

(*b*) £29,000 : (£29,000 + £1,450) :: £100 : price of stock.

$$\frac{£100 \times 30{,}450}{29{,}000} = \underline{£105}.\quad \text{Ans.}$$

FEMALES.

1. Explain the terms *rate per cent., compound interest, discount, bankers' discount, present worth.*

Rate per cent. means the interest of £100 for a year.

Compound interest.—When the interest of money is added to the principal at certain periods, and afterwards interest is calculated on this amount, the interest accruing from this is compound.

Discount is a deduction made from a debt which is paid before it becomes due. Bankers, when discounting a bill, deduct the interest on the amount from the time of discounting till it becomes due. This discount, or banker's discount as it is called, is greater than the 'true discount' by the interest on the latter for the time that the bill has still to run. The sum left after deducting the discount is called the *present worth*. Present worth on a bill of £105, due a year hence, when money is rated at 5 per cent., is £100, £5 being the true discount. Banker's discount would be $\frac{£105 \times 5}{100} = £5\ 5s.$

2. Find the compound interest on £300 for 2 years at 3 per cent.

£3 per cent. gives $\frac{3}{100}$ of the principal as interest per annum.

3 per cent. = $\frac{3}{100}$	£300	= Principal for 1st year.
	9	= Interest ,, ,, ,,
	309	= Principal ,, 2nd ,,
	9·27	= Interest ,, ,, ,,
	318·27	= Amount ,, 2 years.
Deduct 1st principal	300	
	18·27	= Compound Interest.
	20	
	5·40	
	12	
	4·80	

∴ Compound Interest = £18 5s. 4¼d. Ans.

3. If 7 oxen can eat 3 tons of hay in a month, how long will it take 49 sheep to eat 35 tons, an ox consuming 3 times as much as a sheep?

49 sheep : (7 ox. =) 21 sheep } :: 1 month : time
3 tons : 35 tons }

$$\frac{1 \text{ mo.} \times 21 \times 35}{49 \times 3} = \underline{5 \text{ months.}}\quad \text{Ans.}$$

4. Simplify:—

$$\frac{\frac{4}{9} \div \frac{5}{18}}{(\frac{3}{8} \text{ of } \frac{4}{9}) - (\frac{1}{2} \text{ of } \frac{3}{4} \text{ of } \frac{2}{21})}$$

$$\frac{\frac{4}{9} \div \frac{5}{18}}{(\frac{3}{8} \text{ of } \frac{4}{9}) - (\frac{1}{2} \text{ of } \frac{3}{4} \text{ of } \frac{2}{21})} = \frac{\frac{4 \times 18}{9 \times 5}}{\frac{3 \times 4}{8 \times 9} - \frac{1 \times 3 \times 2}{2 \times 4 \times 21}}$$

$$= \frac{\frac{8}{5}}{\frac{1}{6} - \frac{1}{28}}$$

$$= \frac{8}{5} \div \left(\frac{14 - 3}{84}\right)$$

$$= \frac{8 \times 84}{5 \times 11}$$

$$= \frac{672}{55} = \underline{12\tfrac{12}{55}}.\quad \text{Ans.}$$

Grammar.

1. Analyse the following lines:—

'Is this a dagger which I see before me,
The *handle* toward my hand? Come, let me *clutch* thee.'
I have thee not, and yet I see thee still.
Art thou not fatal *vision*, sensible
To feeling as to sight?—or, art thou *but*
A *dagger* of the mind, a false *creation*,
Proceeding from the heat-oppressed brain?

SENTENCES	KIND	CONNECT.	SUBJECT	PREDICATE	OBJECT, &c.	EXTENSIONS
1. Is this a dagger, the handle towards my hand	Prin.		this	is a dagger (with) the handle....hand		
2. which I see before me	subord. adj. to 1	which	I	see	which	before me (place)
3. Come (thou) let (thou) me (to) clutch the	Prin. Prin.	(and)	(thou) (thou)	come let	me (direct) to clutch thee (indirect)	
4. I have thee not	Prin.		I	have not	thee	
5. and yet I see thee still	subord. adv. (concession)	and yet	I	see	thee	still (time)
6. Art thou not fatal vision sensible to feeling	Prin.		thou fatal vision	art not sensible to feeling		
7. as (thou art sensible) to sight	subord. adv. (compar.)	as	(thou fatal vision)	(art sensible) to sight		
8. or art thou but a dagger of the mind, a false creation proceeding from the heat-oppressed brain	Prin.	or	thou	art but a dagger .....brain		

2. Parse fully the words in italics.

Handle—com. noun, neut., sing., obj., gov. by (with), (or nom. absolute 'being' understood).

(to) *clutch*—reg. trans. verb, act., infin., pres., gov. by let.

vision—abstr. noun, neut., sing., nom., agr. with 'thou,' or from being addressed.

but—adv., mod. the phrase 'art a dagger.'

dagger—com. noun, neut., sing., nom., after 'art,' in appos. with 'thou.'

creation—abstr. noun, neut., sing., nom., after 'art,' in appos. with 'thou' or 'dagger.'

3. Illustrate, by examples, the use of the parenthesis.

(*a*) He requested the young doctor, Balthasar (so he called Portia), might be permitted to plead.

(*b*) 'Yet tranquil now that man of crime
(As if the balmy evening time
Softened his spirit) looked and lay.'

(*c*) Antonio signed the bond, thinking it really was (as the Jew said) merely in sport.

4. Give examples of words derived from languages other than the Saxon and the classical.

ENGLISH WORDS FROM OTHER LANGUAGES.

Indian.—Bamboo, salaam, nabob, rajah, ayah.
Turkish.—Divan, sofa, fez.
Dutch.—Boom, block, sloop, skipper, yacht.
Arabic.—Algebra, alembic, almanac, fakir.
German.—Meerschaum, cobalt, feldspar, loafer.
Chinese.—Bohea, tea, junk, mandarin.
African.—Assegai, gorilla, kraal, zebra.

Euclid.

1. Write on Euclid's definition of parallel straight lines.

Parallel straight lines are such as are in the same plane, and which being produced ever so far both ways, do not meet.

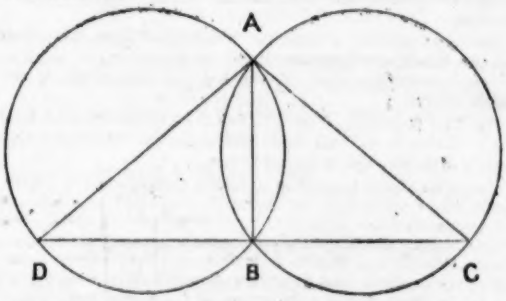
If a straight line fall on two parallel straight lines, it makes the alternate angles equal to one another, and the exterior angle equal to the interior and opposite angle on the same side; and also the two interior angles on the same side together equal to two right angles.

Euclid, Book I., Prop. 29.

2. The angle at the centre of a circle is double of the angle at the circumference on the same base that is on the same arc.

Euclid, Book III., Prop. 20.

3. Two equal circles intersect in A and B, and any straight line DBC is drawn through B to cut both circles. Prove that AC is equal to AD.



Let ADB, ACB be the two equal circles intersecting at A and B. Through B draw the straight line DBC. Join AD, AC, AD shall be equal to AC. Join AB. AB is a chord common to the two circles ADB, ACB, and therefore (III. 28) the arcs are equal, and therefore the angle ADB is equal to the angle ACB (III. 27.) That is, the angle ADC of the triangle DAC, is equal to the angle ACD, and therefore (I. 6) the side AD is equal to the side AC. Q. E. D.

Algebra.

1. Simplify :—

$$\tfrac{1}{6}[x(x+1)(x+2)+x(x-1)(x-2)]+\tfrac{2}{3}x(x-1)(x+1)$$

$$\tfrac{1}{6}[x(x+1)(x+2)+x(x-1)(x-2)]+\tfrac{2}{3}x(x-1)(x+1) =$$

$$\tfrac{1}{6}[x^3+2x^2+x^2+2x+x^3-2x^2-x^2+2x]+\frac{2x^3-2x}{3}$$

$$\tfrac{1}{6}(2x^3+4x)+\frac{2x^3}{3}-\frac{2x}{3}$$

$$\frac{x^3}{3}-\frac{2x}{3}+\frac{2x^3}{3}-\frac{2x}{3}=\underline{x^3}. \text{ Ans.}$$

2. Extract the square root of :—

$$16a^4+81b^4-96a^3b-216ab^3+216a^2b^2$$

$$4a^2 \;\Big|\; 16a^4-96a^3b+216a^2b^2+216ab^3+81b^4 \;\Big|\; \underline{4a^2-12ab+9b^2}$$

$$16a^4$$

$$8a^2-12ab \;\Big|\; -96a^3b+216a^2b^2$$

$$-96a^3b+144a^2b^2$$

$$8a^2-24ab+9b^2 \;\Big|\; \underline{72a^2b^2+216ab^3+81b^4}$$

$$\underline{72a^2b^2+216ab^3+81b^4}$$

3. A party at an inn had a bill to pay among them, but two of them having slipped away, those who remained had each 5s. more to pay; how many were there at first?

Let x = No. at first

then $\frac{200s.}{x} + 5s. = \frac{200s.}{x-2}$

$200x - 400 + 5x^2 - 10x = 200x.$

$5x^2 - 10x = 400$

$x^2 - 2x = 80$

Completing square $x^2 - 2x + 1 = 81$

Taking root $x - 1 = 9$

$x = 9 + 1 = \underline{10}$ = No. at first. Ans.

SECOND PAPER.

(Three hours allowed for this paper.)

Geography.

1. Draw a map of Central America.

2. Describe the principal currents of the Pacific Ocean.

One current, bearing away eastwardly, rounds Cape Horn and enters the Atlantic. Another curves north skirting the coasts of Chili and Peru, turns to the west, and merges into the *Great Equatorial Current* of the Pacific, the northern and southern branches of which hold on due west across the Pacific towards the East Indian Archipelago, but are separated by the *Equatorial Counter-Current* flowing in an exactly opposite direction.

The main portions of both the North and South Equatorial Currents have definite continuations, the former to the south as the *East Australian Current*, the latter to the north as the *Japan Current*.

The East Australian Current, after skirting the coast of New South Wales, turns east and finally merges into the north-easterly drift from the Antarctic Ocean.

The Japan Current, bending round the eastern coast of Japan, divides into a minor drift, setting north along the Kurile Islands, and ultimately finds its way through Behring's Strait into the Arctic Ocean. But the main portion sweeps along the Aleutian Islands, Alaska, and British Columbia, and then curves south, joining the northern branch of the Equatorial Current, having sent a minor branch along the shores of California and Mexico, forming the periodical *Mexican Current*.

3. Tell what you know about Honolulu, Jamaica, Chicago, Hayti, Buenos Ayres, and San Francisco.

Honolulu is the chief town and seaport of the Sandwich Islands on the south side of the island of Woahoo.

Jamaica is the largest and most valuable of the British West India Islands. It is 150 miles long by 40 miles in average breadth. It is traversed from east to west by mountains covered with majestic forests. The principal exports are sugar, rum, coffee, and spices. The capital is Kingston.

Chicago is a large city of the United States on Lake Michigan. A great portion of it was destroyed by fire in 1871. It is said to have made more rapid progress in wealth and inhabitants than any other city in the United States. Its population is over 500,000.

Hayti is, next to Cuba, the largest of the West India Islands. The west part of the island formerly belonged to France, but is now a negro republic with Cape Haytien for its capital; the east part formerly belonged to Spain, but it is now a republic with San Domingo for its capital.

Buenos Ayres is one of the states of the Argentine Republic, but is better known as the capital of the same name on the south shore of the Rio de la Plata. It was founded by the Spaniards, is well fortified, and a place of great trade.

San Francisco, or 'Frisco,' as the Americans like to call it, is a seaport, and the commercial metropolis of California, United States, on an extensive bay of the same name. It is the western terminus of the Pacific Railway, and a great starting place of steamers for Australia and New Zealand as well as for China and Japan.

History.

1. Name the leading men on each side in the Civil War. Give a brief account of *one* of them.

The leading men of the Royalists were Charles I., Prince Rupert, Sir Edward Hyde, Lord Falkland, Marquis of Montrose, and Colepepper.

Among the Parliamentarians were Cromwell, Earl of Essex, John Milton, John Hampden, Sir William Waller, Earl of Leven, Lord Fairfax, Earl of Manchester, Colonel Blake (afterwards Admiral), Sir Harry Vane, and Ireton.

CROMWELL.

Oliver Cromwell was born of a good family at Huntingdon, 1509. He had been twice returned to Parliament before 1640, in which year he represented Cambridge in the Long Parliament, when he was associated with Hampden, Pym, and others, and was one of the first to advocate resistance to the king's measures. In 1642 he received a captain's commission and raised a troop of horse in his native county. So well were his soldiers drilled, that, after Marston Moor, they got the name of Cromwell's Ironsides. At Naseby Cromwell commanded the right wing, and Ireton, his son-in-law, the left. Charles being totally defeated in this battle, ultimately gave himself up to the Scots. In 1649, when it was settled at his trial that Charles should be executed, Cromwell is said to have reluctantly given his assent, but when convinced of the necessity of Charles's death he does not seem to have hesitated about carrying the decision of the court into effect. After the execution Cromwell became a principal member of the council of state. He quelled a mutiny in the army, crossed the Irish sea and conquered Ireland, returned to make war on Prince Charles and the Scots, whom he defeated at Dunbar and Worcester. In 1653, he expelled the Long Parliament and was elected Protector of the Commonwealth, which office he held till his death in 1658.

2. Give a short account of Walpole's administration.

Walpole, assisted by Queen Caroline, began his administration in 1727, when he obtained a decided majority in the new Parliament. Spain made overtures for peace, and a quadruple alliance was established by which peace was maintained for ten years.

During this period, Walpole's skill preserved his power in Parliament in face of an opposition growing in numbers and ability, among whom the great William Pitt the elder made his appearance. In 1733 Walpole carried some important financial measures, but was obliged to withdraw his Excise Bill. He maintained the Septennial Act against all the force of the opposition, and his overwhelming majority in the election of 1735 caused the retirement of Bolingbroke to the continent. The following year was marked by the Porteous riots in Edinburgh. In 1738 differences arose with Spain about the boundaries of Georgia, the right of searching vessels at sea, and the ill treatment of British subjects. The king, the opposition and the people, dragged Walpole into the war which was declared in October 1739. Operations were commenced against the colonies of Spain, and Admiral Vernon took Portobello on the Isthmus of Darien. He failed, however, in a great combined attack on the strong fortress of Carthagena, 1741. The voyage of Anson round the world (1740—1744) arose from these campaigns. The disasters of the war completed the overthrow of Walpole. After the elections of 1741, and repeated defeats in the house he resigned; and died 1745.

Composition.

Write an essay on 'The influence for good or evil exerted by works of Fiction;' or, 'The best method of introducing a class to the study of Fractions.'

THE STUDY OF FRACTIONS.

Having drawn a line on the blackboard, divide it into two equal parts; then, after explanation and questioning on what has been done, get the children to see that the two together are equal to the whole.

Continue by dividing other things, such as apples or oranges, pieces of paper or string, and tell them that the two parts are called *halves*, each of them a *half*, and that two halves make a whole.

The next step in the process might be the division of the line into three equal parts, questioning the pupils in the same manner as before, getting them to see that three-thirds make up the whole. So we may go on with fourths, fifths, &c., till they have a true idea of the different parts, as two-thirds, three-fifths, &c., and how many halves, thirds, fourths, &c., in a whole.

Now may be introduced the expression for a fraction, and referring to the previous way of writing one-half, one-third, &c., show that $\frac{1}{2}$ means one something divided into two, $\frac{1}{3}$ one divided into three, $\frac{1}{4}$ divided into four equal parts. Let them now see that the figure below the line shows into how many parts the object or the line was divided, and the figure above how many of these parts were taken.

We have now reached the stage at which the definition may be given; namely, that 'a fraction (broken part) is a part of a whole,' and then repeat the names of the various fractions given above.

By this time they will begin to know that if $\frac{1}{4}$ be taken from a whole $\frac{3}{4}$ will be left; if $\frac{2}{3}$ be taken from anything, $\frac{1}{3}$ will be left, &c.

Latin.

THIRD STAGE.

(*The answers to be written on a separate paper.*)

1. Translate into English :—

(*a*) His responsis ad Cæsarem relatis iterum ad eum Cæsar legatos cum his mandatis mittit: Quoniam tanto suo populique Romani beneficio affectus, quum in consulatu suo rex atque amicus a senatu appellatus esset, hanc sibi populoque Romano gratiam *referret*, ut in colloquium venire invitatus gravaretur neque de communi re *dicendum* sibi et cognoscendum putaret, haec esse, quae ab eo postularet.

(*b*) Ipse interim in colle medio triplicem aciem instruxit legionum quatuor veteranorum; sed in *summo* jugo duas legiones quas in Gallia citeriore proxime conscripserat, et omnia auxilia collocari ac totum montem hominibus compleri et interea sarcinas in unum locum conferri et eum ab his, qui in superiore acie *constiterunt* muniri jussit.

TRANSLATION.

(*a*) These answers being brought to Cæsar, Cæsar a second time sends ambassadors to him with these instructions: That whereas after being treated with so much kindness on his own part and that of the Roman people, since in his own consulship he had been styled king and friend by the senate, he was making such a return as this to himself and the Roman people as that he should, when invited to come to a conference, make a difficulty about it and think that it was not incumbent upon him to become thoroughly acquainted with an affair of common interest; that these were the things which he had to ask from him.

(*b*) He himself, meantime, drew up on the middle of the hill a triple line of four veteran legions; but he ordered the two legions which he had levied in hither Gaul to be posted on the summit of the hill and all the auxiliaries, and all the mountain to be filled with men, and in the meantime the baggage to be collected into one place and that it be guarded by those who stood posted in the upper line.

2. Parse fully the words printed in italics in the above passages.

What is the construction of subordinate clauses after verbs of feeling and declaring? When may 'that' be translated by 'ut?'

Translate into Latin :—

(*a*) The captives will be bound by the soldiers, and the city will be destroyed by fire.

(*b*) The king pardoned the slave, and promised to set him free.

(*c*) We have come to bury Cæsar, not to praise him.

PARSING.

Referret—irreg. trans. verb, act., 3rd conj. (*refero—tuli—latum—ferre*), subj., imperf., 3rd, sing., agr. with 'is.'
dicendum—trans. verb, pass., gerundive, 3rd conj. (*dico, dixi, dictum, dicere*), agr. with 'eum.'
summo—abl., sing., neut., adj., 1st and 2nd decl. (*summus—a—um*), superl. deg. of superus, superior, supremus, or summus.
Constiterunt—trans. verb, act., 3rd conj. (*consisto—stiti—stitum—sistere*), indic., perf., 3rd pers., plur., agr. with 'qui.'

Verbs of feeling and declaring are followed in subordinate clause by the accusative with the infinitive.

Verbs denoting the outward expression of feeling are often followed by 'quod,' and those that express wishing, especially 'opto,' by 'ut.'

'That' is to be translated by 'ut' when it means 'in order that,' 'granting that,' or 'so that;' and also after such words and phrases as, Contingit, evenit, accidit, reliquum est, &c., mos est, jus est, &c.

TRANSLATION.

(*a*) Capti a militibus vincientur, et urbs igne comburetur.

(*b*) Rex veniam servo dedit, et se eum liberaturum promisit.

(*c*) Ut Cæsarem sepeliamus, ne eum laudemus, venimus.

Needlework.

FIRST YEAR.—Knit the heel of a sock suitably for a boy of ten.

Sew on a tape and button on a band of calico.

SECOND YEAR.—Fix and work a hem six inches in length.
Fix and run three tucks.

THIRD YEAR.—Darn a hole one inch square on a stocking web material. (Common method.)

FOURTH YEAR.—Darn on coarse linen a diagonal cut half an inch long.

—o—

Publications Received.

Bell, G., and Sons—

Examples in Arithmetic. By C. Pendlebury, M.A.
Barnett's Notes on King Henry V.
Arithmetic. By C. Pendlebury, M.A.
Bell's Reading Books: The Talisman; Life of Columbus.
The Ajax of Sophocles, with Notes. By F. A. Paley, M.A., LL.D.
The Schoolmaster's Calendar. 1888.

Blackie and Son—

Poynter's Drawing for the Standards. Books 11, 16, 21, 22.

Cassell and Co., Limited—

Cassell's Higher Class Readers:—
The World's Lumber Room.
Short Studies from Nature.
A Ramble round France.
All the Russias.
Chats about Germany.
The Land of the Pyramids.
The Eastern Wonderland.
The Land of Temples.
Peeps into China.
Glimpses of South America.
Round Africa.
The Isles of the Pacific.

Chambers, W. and R.—

The Standard Algebra. Part I.
Lives of Good and Great Women.

Curwen, J., and Son—

School Cantata: The Armada. By A. J. Foxwell.
" " Life at Sea. By T. M. Pattison.
The Musical Inspection; How to Prepare for it.
The Tonic Sol-Fa Reporter. March.

Gill, G., and Sons—

Guide to the Scholarship Examination. By Benson Clough.

Heywood, John—

The Premier Table Book.
Local Examination History. By Dr. Pringle.
The Art of Speaking. By the Rev. Hardie Ford.
The Junior Church Catechism. By M. T. Yates.

Isbister, W., Limited—
Natural History Object Lessons. By G. Ricks, B.Sc.

Longmans and Co.—
Social Habitations, &c. By the Rev. J. G. Wood.
Heroes of the Arctic Regions. By Dr. Hartwig.
Wonders of the Tropical Forests. By Dr. Hartwig.
Prosperity or Pauperism? By the Earl of Meath.
Commercial Précis-Writing. By the Rev. T. Hunter, M.A.

Nelson, T., and Sons—
The Great Events of History (Royal Upper Class Readers).

Relfe Bros.—
First Principles of Modern History. By J. S. Taylor.
How to Spell and Speak English.
Notes on the Church Catechism. By the Rev. A. Towsey, M.A.
Dates made Easy. By J. Hugh Hawley.

Smith, Elder and Co.—
The Cornhill Magazine. March and April.

Swan Sonnenschein and Co.—
The Cyclopædia of Education. Parts II. and III.
A First History of the English People. Vols. 1 and 2. By Amy Baker.

The Clarendon Press—
Geometry in Space. By R. C. J. Nixon, M.A.

The National Society's Depository—
The National Test Cards. Standards I. to VII.

Whittaker and Co.—
Whittaker's French Series:—
Galland's Ali Baba. By Emile Clare.
Scribe's Le Verre d'Eau. By A. Barrère.
Piron's La Métromanie. By Leon Delbos.
Intermediate German Course. By F. Lange.
Doktor Wespe (Benedix). By F. Lange.

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. FORLORN.—Of the capitals nearly all the letters are of the wrong shape. The remedy is to buy a good copy book and practice. If you have read this column in past months you will have learned what to do. In regard to some of the numbered letters there is little choice. Some you have put in the small hand are only small editions of large hand, while some of those in the large hand are small hand letters 'writ large.'

2. L. M. N.—We think you have the best edition. You only want portions of it, the whole is rarely read. For your own reference let us call your attention to Saintsbury's 'History of Elizabethan Literature,' one volume. It contains a criticism upon the work you name. There are also references in Angus' 'English Literature' and Morley's 'First Sketch of English Literature.'

3. N. G.—We really cannot say. It might do so if it were a very bad performance. We think, however, that you could hardly do wrong to wait a year, and in the meantime try to improve upon the last effort. You would also be better prepared for the examination itself.

4. BOG.—You order your book through a bookseller. He may not know the publisher, but when his order reaches his London agent he will know in most cases where to get the books from. Don't trouble about that; merely order. If there are two booksellers in the town, sharpen the dull one by ordering your books of the one who gets what you ask without pestering you with too many questions. If you had to come to London and buy your books what you ask might be serviceable, but we assure you that if you gave the London collector all the details you mention you would hinder, not help him. The price is another matter. No doubt that is convenient to know. The books, however, are none of them very dear, and one cannot always verify the price without great trouble. Pestalozzi; yes to both questions. In theoretical music only.

5. G. H.—We must verify your question first.

6. JET.—We do not remember receiving your queries before. (*a*) Latin—sufficient. (*b*) French—sufficient. We presume your edition of 'Arnold' is a recent one by Bradley. Macmillan's 'Progressive French Course,' Part III., contains excellent material for French composition. We have but one piece of advice to give you, and that is, write your exercises carefully, have them corrected and understand why they are altered, and profit by the emendations. Merely writing exercises is no use. In regard to 'Comus' you can use the Clarendon Press edition, and so of the others.

7. CONSTANT SUBSCRIBER.—You can write to the Secretary of the Royal Geographical Society, Burlington House, Piccadilly, W. He will, if you ask him, send you a form of application and the other information you require.

8. TOMMY.—We think the matriculation would be far the best for you if you could do it. It would, however, take you longer than the other examination you name. Make your selection, and then write to the secretary, and get the new syllabus. Having done that we will give you any advice we can upon the best and shortest course to take.

9. TAU.—For the same reason that it would be sufficient to cover it with a sheet of wire gauze.

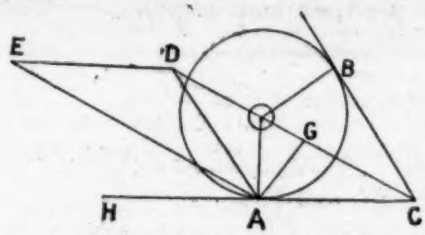
10. HELENA.—You may judge whether a word is likely to be of Latin origin by its prefix or suffix. Further, you can remember that no article, pronoun (except one), and few prepositions or conjunctions are of Latin origin. In case the word came to us through the French, the termination would often give evidence of it.

11. L. M.—You will not be able to obtain a parchment by service in the school you name. You can only do that by serving in a school which is inspected by one of Her Majesty's Inspectors. The second part of your query is therefore disposed of at the same time.

12. ———.—You could not do better than study the articles now passing through this magazine upon Pestalozzi.

13. HAUGHTON'S MECHANICS.—We will refer to the book and look at the question and give you our opinion next month.

14. MAGISTER.—(*a*) If a particle moves uniformly in a circle with speed v, what is its change of velocity after it has described an arc of 120°.



We have not been able to find the book you quote from. But the phraseology indicates that velocity is used in the new meaning of a vector or directed quantity. The velocity of the particle is constant in amount but varying in direction. The question really means what velocity added to the original velocity will give the final velocity. Let us call AC the initial velocity in magnitude and direction. Then the angle AOB = 120 and the final velocity is in the direction CB or AD, and its magnitude is the same as at first (the speed being uniform), it has only changed in direction. AC is a component velocity and AD is the resultant velocity, what is the other component? Join CD, through D draw DE parallel to CA, and through A draw AF parallel to CD; we have to determine AF in magnitude and direction. In magnitude AF = CD. Draw AG perpendicular to CD; then since AOB = 120° and the angles CAO and CBO are right angles, the angle ACB = 60°, but as CB and CA are tangents and O is the centre of the circle the angle ACB is bisected.

Hence the triangle ACG is half an equilateral triangle, and

$\therefore$ the altitude $CG = \frac{\sqrt{3}}{2}$ AC.

But since AC = AD the perpendicular AC bisects CD,

$\therefore$ CD $= 2 \times \frac{\sqrt{3}}{2}$ AC.

But CD is the added velocity and if AC the initial velocity $= v$

$$CD = \sqrt{3}\, v.$$

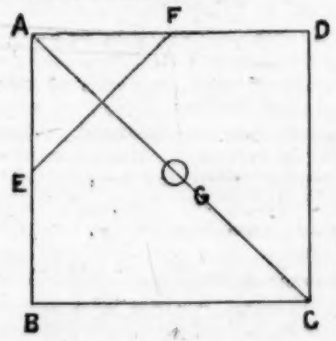
For the direction of CD we must determine the angle CAF.

Now AF was drawn parallel to CD and we have shown that the angle ACG is 30°.

$\therefore$ The angle FAH is 30°,

$\therefore$ The angle CAF is 180 − 30 = 150°.

(*b*) From a square a portion is cut off by a line passing through the middle points of two adjacent sides. Find the centre of gravity of the remainder.



Let ABCD be the square, O the centre of gravity, G the centre of gravity of the remainder, then let the corner A be cut off; join AC.

The piece cut off, AEF, is evidently $\frac{1}{8}$ of the square; the centre of gravity of AEF is K which is $\frac{2}{3}$ of AH and $\therefore \frac{1}{12}$ AO.

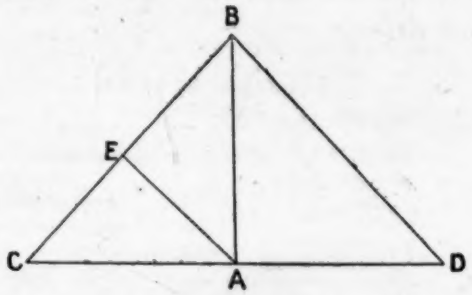
Let AO be unity and $\frac{OG}{AO}$ or $\frac{OG}{OC} = x$.

Then taking moments about A we have

$$\tfrac{1}{8} \times \tfrac{1}{12} + \tfrac{7}{8}(1 + x) = \tfrac{6}{8} \times 1$$
$$\tfrac{1}{96} + \tfrac{7}{8} + \tfrac{7}{8}x = 1$$
$$\tfrac{7}{8}x = 1 - \tfrac{7}{8} - \tfrac{1}{96} = \tfrac{7}{96}$$
$$\therefore x = \tfrac{7}{96} \times \tfrac{8}{7} = \tfrac{1}{12}.$$

15. J. W. DUCK.—Jevon's 'Logic,' 1s.; Curtis' 'Dates,' 1s.; Capel's 'Catch Questions,' 4s. 6d.; Justin Macarthy's 'History,' 6s.; 'Julius Cæsar' (Wright), *net* interleaved, 1s. 6d.; Macaulay's 'Addison' and 'Milton,' 6d. each.

16. JEAN.—A spar of uniform section of length l, and weight w, has an end pivoted in the ground, and is stayed in a position inclined to the vertical by two ropes, each of length b, attached to it at a distance c from the pivoted end, and attached to their other extremities to rings fastened in the ground, each at a distance a from the pivot, and in directions which contain an angle θ at the pivot. Find an expression for the tension in each rope.



Let AB represent portion of spar (c), BC, BD the ropes (b), and AC, AD = a. In the triangles BAC, BAD, the three sides are equal, therefore angle BAC = angle BAD, wherefore it is evident that AB is perpendicular to CD, and *not* inclined to the vertical.

Draw AE perpendicular to BC.

Then, Tension in BC × AE $= \frac{1}{2} w$;

By similar triangles AEC, BAC,

$$\frac{AE}{AC} = \frac{BA}{BC},$$

$$\therefore AE = \frac{BA \times AC}{BC}$$

$$= \frac{c \times a}{b};$$

$$\text{Tension in BC} \times \frac{ac}{b} = \tfrac{1}{2} w,$$

$$\therefore \text{Tension in each rope} = \tfrac{1}{2} w \times \frac{b}{ac}$$

$$= \tfrac{1}{2} \frac{bw}{ac}.$$

Algebra.

1. MYNNYDOG.—What is meant by the radix of a scale of notation? Prove the rule for square root.

The radix of a scale of notation is the base of a system of numbers.

Since $(a + b)^2 = a^2 + 2ab + b^2$, therefore $a + b$ is the square root of $a^2 + 2ab + b^2$, and from this the rule for the extraction of the square root may be obtained.

$$\begin{array}{rl} & a^2 + 2ab + b^2 \,(a + b \\ & a^2 \\ \hline 2a + b & \big| \; 2ab + b^2 \\ & \underline{2ab + b^2} \end{array}$$

Take the square root of 1849.

$$\begin{array}{rl} & \begin{array}{cc} a & b \end{array} \\ & 1849\,(40 + 3 \\ a^2 = 1600 & \\ \hline 80 + 3 & \big| \; 249 \\ (2a + b & \big| \; \underline{249} = 2ab + b^2 \end{array}$$

The ciphers may be omitted for the sake of brevity.

$$\begin{array}{rl} & 1849\,(43 \\ & \underline{16} \\ \hline 83 & \big| \; 249 \\ & \underline{249} \end{array}$$

2. M.H.—A boy saves 1½d. one week, 3d. the next, 4½d. the next, and so on; how long will he be accumulating £111 0s. 9d. in this manner?

This is a question in Arithmetical Progression, where sum = £111 0s. 9d., first term = 1½d., difference = 1½d., and number of terms is required.

Sum = 53,298 half-pence
First term = 3 half-pence
Difference = 3 ,,

$$S = \left\{2a + (n-1)d\right\}\frac{n}{2}$$

$$\therefore\ 53{,}298 = \left\{6 + 3(n-1)\right\} \times \frac{n}{2}$$

$$= (6 + 3n - 3) \times \frac{n}{2}$$

$$106{,}596 = n(3n + 3)$$

$$35{,}532 = n(n + 1)$$

$$n^2 + n = 35{,}532$$

$$n^2 + n + (\tfrac{1}{2})^2 = 35{,}532 + \tfrac{1}{4}$$

$$= \frac{142128}{4}$$

$$n + \tfrac{1}{2} = \pm 377\tfrac{1}{2}$$

$$\therefore\ n = \pm 377\tfrac{1}{2} - \tfrac{1}{2}$$

$$= 188, \text{ or } -189.$$

$$\therefore \text{ Time} = 188 \text{ weeks}$$

$$= \underline{3 \text{ years } 32 \text{ weeks.}} \quad \text{Ans.}$$

3. ALPHA.—Solve:—

$$\frac{2 + 6y - 4x}{3z - 4} = \frac{4 + 5z - x}{2y - 3z - 1} = \frac{y - 2z - 1}{1 + 3y - 2x} = 1.$$

(*College of Preceptors*, 1882.)

$$(1)\quad \frac{2 + 6y - 4x}{3z - 4} = 1$$

$$2 + 6y - 4x = 3z - 4$$

$$-4x + 6y - 3z = -4 - 2$$

$$4x - 6y + 3z = 6.$$

$$(2)\quad \frac{4 + 5z - x}{2y - 3z - 1} = 1$$

$$4 + 5z - x = 2y - 3z - 1$$

$$-x - 2y + 5z + 3z = -1 - 4$$

$$x + 2y - 8z = 5.$$

$$(3)\quad \frac{y - 2z - 1}{1 + 3y - 2x} = 1$$

$$y - 2z - 1 = 1 + 3y - 2x$$

$$2x + y - 3y - 2z = 1 + 1$$

$$2x - 2y - 2z = 2$$

$$x - y - z = 1.$$

(2) $x + 2y - 8z = 5$
(3) $x - y - z = 1$

Subtracting] $3y - 7z = 4.$ (4)

(1) $4x - 6y + 3z = 6$
(3) $4x - 4y - 4z = 4$

Subtracting] $-2y + 7z = 2.$ (5)

(4) $3y - 7z = 4$
(5) $-2y + 7z = 2$

Adding] $\therefore\ y = 6.$

(5) $-2y + 7z = 2$

$$7z = 2 + 12$$

$$= 14$$

$$\therefore\ z = 2.$$

(3) $x - y - z = 1$

$$x = 1 + 6 + 2$$

$$\therefore\ x = 9.$$

$$\therefore\ \underline{x = 9,\ y = 6,\ z = 2.} \quad \text{Ans.}$$

Arithmetic.

1. DAFFODIL.—In a school $\frac{3}{5}$ of the number on the register are boys, $\frac{3}{10}$ girls, and 120 infants. How many boys and girls are there?

$$\text{Part infants} = 1 - (\tfrac{3}{5} + \tfrac{3}{10})$$

$$= 1 - \frac{4 + 3}{10}$$

$$= 1 - \tfrac{7}{10}$$

$$= \tfrac{3}{10};$$

$$\tfrac{3}{10} \text{ of scholars} = 120,$$

$$\therefore \text{ No. of scholars} = \frac{40}{120} \times \frac{10}{3}$$

$$= 400;$$

No. of boys = $\frac{3}{5}$ of 400 = 160
,, girls = $\frac{3}{10}$ of 400 = 120 Ans.

Mensuration.

1. MATER.—A rectangle is 5 times as long as it is broad, and its area is 405 sq. yds.; find its perimeter. (*Senior's* 'My first Mensuration.')

Length × Breadth = Area;
5 times Breadth × Breadth = 405 sq. yds.,
5 times Breadth² = 405 sq. yds.,
Breadth² = 81 sq. yds.,
∴ Breadth = 9 yds.
∴ Perimeter = 2 (45 + 9) yds.
= (54 × 2) yds.
= 108 yds. Ans.

Pupil Teachers' Preparation Papers.

A GOODLY number of pupil teachers of all years and of both sexes availed themselves of our offer to examine their answers to the Test Paper in our March number. These answers were all returned on the 20th March, so that nearly five weeks would elapse from that date to the Government examination. The papers were of all kinds—good, bad, and indifferent; and we would now draw attention to the chief faults in them for the benefit of all who are to be examined.

A common fault was—*Inattention to the directions given.* For example: three sums were asked for, yet quite frequently four were attempted. All work done beyond what is required is absolutely thrown away. The maximum of marks can be obtained by doing what is required. If more is attempted valuable time which might be given to other subjects is wasted, and marks are lost.

Another common fault was—*Making answers too long.* Several pupil teachers gave answers to one question covering two or even three pages of foolscap. The consequence was that a second or third answer was compressed into three or four lines. Two or three answers of average length would obtain many more marks than one very long one, and two very short ones. Remember that a scale of marks is supplied to every inspector, the maximum for each question being given. That scale was adopted by our examiners for the Test Paper, and those who forwarded them will be able to see how the tests are applied by the inspectors.

Most attention needs to be paid to Grammar, and especially to Parsing and Analysis. Even with third

and fourth year teachers it was quite a common mistake to find a participle alone as a predicate, and while a word was put into the *object* in analysis it was said to be nominative case in the parsing. If the parsing is given as one question it almost invariably carries double the marks of any other question in the subject. The greatest care, therefore, should be taken with it.

Closely allied with this subject, and reckoned along with it as a failing subject, is that of Composition. This, on the whole, was well done, but many pupil teachers *punctuate badly*. A precise and concise style should be attempted. Do not try to make long, involved sentences, but when once you have said a thing come to a full stop, and begin another sentence.

In Arithmetic the definitions were poor. To avoid this *definitions should be committed to memory*. The question which asks for a definition or which asks for a process to be given or explained is worth ten more marks than any other. The map in Geography is also most valuable, whereas it is nearly always done worse than either of the other questions. Meridians and parallels are worthless unless numbered, and if not numbered correctly they had better be left out altogether.

Great complaints have been made about *want of time* to answer the questions. There is a great deal to be done in the time allotted, but if teachers have worked steadily all through the year, and will do just what they are told and avoid prolixity, they will generally be able to obtain full marks.

Read carefully the hints given in the previous numbers of the PRACTICAL TEACHER, as well as this paper, and if you have worked steadily during the year, and keep these precepts in mind, success will attend your trial on the 21st inst.

Bearing in mind what has been said about the value of certain questions, so far as written work goes, the following may be taken as the scale of marks in use. We should advise all pupil teachers to make a copy of it for future reference, and especially that part which deals with the full examination.

Arithmetic—(four questions given, three to be done), 30, 30, 30 and 40 marks. *Grammar* (four or five questions given, three to be done), as a rule 20 for each answer, except one, which has 40. *Geography* (four given, three required), 25, 25, 25, 30. *History*, the same as Geography. *Euclid* (three given—two wanted), 20, 20, 30. *Algebra*, the same as Euclid. *Mensuration* (two given, one wanted), 20, 20. *School Management* or *Teaching* (four, five or six given, two wanted), each worth 20. *Music* (three given and wanted), 13, 13, 14.

Any teacher under examination may thus be able to estimate roughly the marks obtained, if sure that the answers are good ones. But other considerations apply when the earning of the 40s. or 60s. is concerned. Unless 40 per cent. of the marks be obtained in every subject except Geography, History, and Music, no grant at all can be earned. Fifty per cent. of *all* the marks obtainable will earn the 40s. grant, and 75 per cent. the 60s. grant. For the purpose of reckoning, the subjects bracketed below are considered together as one subject.

EDUCATION DEPARTMENT'S SCALE OF MAXIMUM MARKS FOR PUPIL TEACHERS AND CANDIDATES.

		Total.
Reading	45	90
Recitation	45	
Handwriting (judged by all the papers)	40	80
Spelling (ditto)	40	
Arithmetic		100
Grammar	80	120
Composition (all papers)	40	
Geography		80
History		80
Mathematics:		
Euclid	50	120
Algebra	50	
Mensuration	20	
Music		40
Needlework:		
Garments at home	30	90
Work at Examination	60	
Teaching:		
Practical skill (shown in school)	80	120
Knowledge of method (paper work)	40	

A male pupil teacher may thus get 830 marks, and a female pupil teacher 800 marks. Less than 35 per cent. of this total involves a warning that failure to the same extent next year will prevent the recognition of the pupil teacher as part of the school staff. Less than 35 per cent. in any subject will involve a warning (a * or ° against the name of the pupil teacher in the annual report on the school), while if less than 50 per cent. the pupil teacher will be cautioned, that is, the subject will be placed opposite his name in the report. All pupil teachers should try to take the music paper, as the 40 marks for that subject are included in the totals to be obtained. The totals for first and second year male teachers are less than for the others, because in the one case they do not take Mathematics and School Management, and in the other they do not take Algebra and Mensuration.

Below we print a half-yearly Test Paper for the October teachers. We repeat the offer made last month, and will examine and return postage paid any set of them which reaches us by the 10th inst.

TEST PAPER FOR PUPIL TEACHERS WHO ARE TO BE EXAMINED IN OCTOBER.*

[NOTE: This paper covers half the work of the year, and is designed to test the accuracy of the previous six months' work. It is similar to the papers which the writer has set for many years to one of the largest Pupil Teacher Examination Associations in the country. *No pupil teacher should omit to try it.*]

Directions.

1. Write on half sheets of foolscap, and on one side only.

2. At the top of each half sheet write your name in full; also the full name of your school, and the year whose papers you are answering.

3. Do not write the questions, but prefix to each answer the number of the question to which it corresponds.

4. Do not use any book or writing from which answers may be copied.

5. If you have not time to answer all the questions in any subject, choose those you can answer the best; but do not omit the whole of any one subject.

6. Keep strictly to the time allowed.

END OF FIRST YEAR.

Three and a half hours allowed.

Arithmetic.

(*Do three sums only.*)

MALES.

1. What is meant by an improper fraction? Give names to each of the following fractions :—$\frac{7}{10}$, $5\frac{1}{3}$, $\frac{13}{7}$, $\frac{3\frac{1}{2}}{7\frac{1}{4}}$, $\frac{5}{8}$ of $3\frac{1}{2}$ of $7\frac{1}{4}$. (30)

2. Find the L. C. M. of 4, 9, 10, 15, 21, 18, and 20; and the G. C. M. of 1,020 and 6,630. What is meant by the Greatest Common Measure and the Least Common Multiple? (40)

3. $7\frac{3}{8}$ of $365\frac{1}{4}$ days + $3\frac{5}{10}$ of $\frac{5}{6}$ week + $\frac{3}{4}$ of $5\frac{1}{2}$ hours − $\frac{4}{5}$ of 6,339 days 30 minutes. (30)

4. What fraction of 2 miles 1 fur. 36 poles 3 yds. is 2 fur. 15 poles $2\frac{1}{2}$ yds.? (30)

FEMALES.

1. Find the cost of 1,456 articles at 14s. $6\frac{1}{2}$d. each. (30)

2. $232\frac{5}{8}$ articles at £418 4s. $1\frac{1}{2}$d. each. (35)

3. Find the value of 1 lb. 1 oz. 10 dwts. at £1,178 16s. 8d. per lb. (30)

4. Make out and receipt the following bill :—3 lbs. tea at 3s. $2\frac{1}{4}$d. per lb., 20 lbs. of biscuits at $10\frac{1}{2}$d. per lb., 5 stone and 2 lbs. best tea at 3s. $1\frac{3}{4}$d. per lb., 6 lbs. green tea at 4s. $1\frac{1}{4}$d. per lb., $1\frac{1}{4}$ stones of flour at 1s. 8d. per stone.

Geography.

MALES AND FEMALES.

(*Answer three questions only.*)

1. Draw a full map of England south of the Thames, Ulster, or Wales. Insert parallels if you can. (30)

2. Name the principal towns in England and Scotland engaged in the cotton, woollen, and iron trade. (25)

3. Say what you can briefly of Aberdeen, Ben Nevis, Bala, Neagh, Limerick, Valentia, Bristol, St. Helen's, Middlesborough, Wrekin. (25)

4. Name the foreign possessions of Britain. (25)

Grammar.

(*Answer Questions 1 and 2, and one other question.*)

1. The western waves of ebbing day
Rolled o'er the glen their level way,
Each purple peak, each flinty spire,
Was bathed in floods of living fire.
A summer night in greenwood spent
Were but to-morrow's merriment. *Scott.*

Analyse these six lines. (25)

2. Parse the last two lines. (35)

3. Give six examples of the ordinary terminations of English nouns. (20)

4. How do you distinguish transitive and intransitive verbs? What is meant by *voice* applied to verbs? Write a sentence in the active voice, and one in the passive voice. (20)

Composition.

(*Read the following once only, and then write it from memory.*)

One of the most stoutly defended places on the field of Waterloo was a farmhouse with an orchard surrounded by a thick hedge. Our soldiers were told to hold it against the enemy at any hazard and any sacrifice. The French were beaten back many times, but at last the powder and ball were running short, the hedges had taken fire, and the orchard was surrounded by a ring of flame. A messenger had been sent for more ammunition, and soon two loaded waggons neared the spot. The driver of the first, with the reckless daring of an English boy, spurred his horses through the burning hedge, but the flames caught the powder, and in an instant horses, waggon and driver were blown into fragments. The second driver was appalled, but seeing that the shock had beaten the flames back, he dashed his horses at the breach, and amid the deafening cheers of the garrison landed his terrible cargo safe within. The Duke of Wellington is said to have spoken of this as one of the bravest deeds of the whole battle. (40)

History.

(*Answer three questions only.*)

1. What means did the Romans take to keep back their enemies in the north of Britain? Give dates. (25)

2. Who were Julius Agricola, Caractacus, Boadicea, and Egbert? (25)

3. How did the Saxons divide Britain after they had conquered it? Draw a rough sketch map showing the position of these divisions if you can. (30)

4. Write a short account of the condition of the people of Britain before and at the close of the Roman occupation of Britain. (25)

END OF SECOND YEAR.

FIRST PAPER.

(*Three and a half hours allowed.*)

Euclid.

MALES.

(*Answer two questions, including Question 3, if you can.*)

1. Upon the same base and on the same side of it there cannot be two triangles having their two sides terminated in one extremity of the base equal to one another and likewise those terminated in the other extremity. (20)

2. If two straight lines cut one another, the vertical or opposite angles are equal to one another. (20)

3. Given two points one on each side of a given line; find a point in the line such that the angle contained by two lines from it to the given points may be bisected by the given line. (30)

Arithmetic.

MALES.

(*Do three sums only.*)

1. What is interest? What is the difference between the simple and compound interest of £450 for $2\frac{1}{2}$ yrs. at 4 per cent. per annum? (40)

2. Oranges are bought at 2·5 shillings for 40. What must I sell a dozen of them at, so as to gain ·25d. on each orange? (30)

3. If £781 put out on loan produce £16 5s. 5d. in 5 months, how much interest will £589 produce in 8 months at the same rate?

4. What principal will produce £8 6s. 6d. in 2 yrs. 6 months at 4 per cent. per annum?

FEMALES.

Answer the questions set for First Year Males.

Grammar.

MALES AND FEMALES.

(*Answer Questions 1 and 2, and one other question.*)

1. Ah, *none but* in this *iron* age would do it!
The iron of itself though *heat red-hot*
Approaching near these eyes would drink my tears,
And quench his fiery indignation
Even in the matter of *mine innocence*;
Nay, after that *consume* away in rust,
But for *containing fire to harm* mine *eye*.
Shakespeare.

Analyse lines 2 to 7. (20)

2. Parse the words in italics. (40)

3. Write the meaning of the above passage in your own words. (20)

4. What are auxiliary verbs and participles? Give the different uses of all the auxiliary verbs. (20)

Geography.

(*Answer three questions only.*)

1. Draw a full map of France or Italy, or a map of the Mediterranean or the Baltic Sea, showing the rivers which empty themselves into them, and the ports on their shores. (30)

2. Describe the surface of Europe. (25)

3. Name in order the ten largest towns in Europe, and say for what each is noted, and where it is situated. (25)

4. Compare the physical features of Scandinavia and Holland.

SECOND PAPER.

(Two and a half hours allowed.)

History.

(Answer three questions only.)

1. Write an account of the reign of King John. (25)

2. State all you know of the decline of the power of the king and the increase of the power of the people during the Norman and Plantagenet period of English History. (30)

3. Describe the conquest of Wales, or the attempt to gain possession of Scotland by Edward I. (25)

4. Say all you can of the subjugation of Ireland in the twelfth century. (25)

Teaching.

(Answer two questions only.)

1. Explain briefly, as to a class, the meaning of the following passage :—

How in the noon of night that pibroch thrills,
Savage and shrill ! but with the breath which fills
Their mountain pipes, so fill the mountaineers
With the fierce native daring which instils
The stirring memory of a thousand years :
And Evan's, Donald's fame rings in each clansman's ears.
(20)

2. Why should a teacher read to his class ? Write the verbal orders you have to give to maintain discipline during your reading lesson. (20)

3. What are the qualities of good reading ? (20)

4. Write a specimen of a copy in large hand and a copy in small hand for the blackboard. To what points in the copies would you specially draw the attention of the children ? (20)

END OF THIRD YEAR.

FIRST PAPER.

(Three and a half hours allowed.)

Euclid.

MALES ONLY.

(Answer two questions, including question 3 if you can.)

1. If a side of a triangle be produced the exterior angle is equal to the two interior and opposite angles. (20)

2. The opposite sides and angles of a parallelogram are equal, and the diagonal bisects it, that is, divides it into two equal parts. (20)

3. Find the value of an angle of a regular hexagon, and the angle of a regular octagon, and prove the truth of your answer. (30)

Algebra.

MALES ONLY.

(Answer two questions, including question 3 if you can.)

1. If $a = 8$, $b = 6$, $c = 5$, $d = 4$, $e = 3$, $f = 2$, find the value of

$$\frac{4adf - 4cde + 2d}{3bce - 5ab - 3ef} - \frac{3ad - bd}{2bc + 3d} - \frac{7df - 11c}{7e - 2cf}. \quad (20)$$

2. Find the sum of

$3x^2y - 4x^2y^2 + 5xy^2 - 4x^2z$, $5x^2z - 5x^2y + 7x^2y^2 - 9xy^2 + 4x^2z$, $-3xy^2 - 5x^2y^2 - 2x^2y$, $3x^2y - 6x^2z + 6xy^2 + x^2y^2$, and from $(m-n)x^2 - (n+p)x$ take $(m-n)x^2 - (n+p)x$. (20)

3. What is Algebra ? What are positive and negative quantities ? When are algebraic quantities said to be *like* and when unlike ? What is the rule of signs in multiplication ? In division ? (30)

Mensuration.

MALES ONLY.

(Answer one question only.)

1. Find the area of a footpath $1\frac{1}{4}$ feet carried on all sides of a square, the area of which is 186,624 square feet. (20)

2. What is the area of a triangle whose sides are 11, 12 and 14 yards respectively ? Give the answer in yards, feet, and inches. (20)

Arithmetic.

FEMALES ONLY.

(Answer three questions only.)

1. What is a decimal fraction ? Convert $\frac{3}{125}$ and $\frac{5}{8}$ into decimals.

2. State the rule for pointing in addition, subtraction, and multiplication of decimals.

Multiply 3·087 by ·0875 and their product by 8·35.

3. What is the value of

$$\frac{10{\cdot}235 \times {\cdot}087}{7{\cdot}42 + 1{\cdot}36 + 2{\cdot}72}$$

4. If 577 books cost £72 2s. 6d. how many can I buy for £128 2s. 6d. ?

Grammar.

(Answer questions 1 and 2, and one other question.)

MALES AND FEMALES.

1. *Blithe were it* then to *wander* here !
But now—*beshrew* you nimble *deer*—
Like that same hermit's, *thin* and spare,
The copse must give my *evening fare*.
Some mossy bank my couch must be,
Some rustling oak my *canopy*.

Paraphrase the above passage. (20)

2. Analyse it and parse the words in italics. (40)

3. Give the meaning of these prefixes, and three words in which each is used, with the meaning of the word :—ob-, ex-, in-, bene-, sub-. (20)

4. How would you explain *voice* to the Fifth Standard ?

Geography.

MALES AND FEMALES.

(Answer question 1 and two other questions only.)

1. Draw a map of Arabia, or Further India. (30)

2. Write a description of Siberia, Persia, or Afghanistan. (25)

3. What are the chief physical features of Asia ? (25)

4. Describe the course of the Ganges, Indus, or Euphrates and Tigris. (25)

5. What vegetable and other products do we procure largely from Asia ? (25)

SECOND PAPER.

(Two hours and a half allowed.)

(Needlework for Females. *One hour.)*

Arithmetic.

MALES ONLY.

(Answer three questions only.)

1. A garrison of 1,200 men have provisions sufficient to last them 6 weeks, allowing each man 15 ounces a day. If reinforced by 600 men, and are then only allowed three-quarters of a pound each per day, how long would the provisions then last ? (30)

2. A fruiterer bought oranges at the rate of 4s. 6d. for 120. What number must he sell for 1s. so as to gain $33\frac{1}{3}$ per cent. ? (30)

3. What is the discount on a bill for £450 due October 8th and discounted September 11th at $3\frac{3}{4}$ per cent. per annum ? (30)

4. What is *discount ? Present worth ?*

If I sell out £5,680 stock from the 3 per cents. at 92, what money do I receive, and what will be the change in my income if I invest the proceeds in the 4 per cents. at 106 ? (40)

History.

MALES AND FEMALES.

(Answer three questions only.)

1. Write a list of the chief events of the reign of Charles II., with dates, and give a full account of one of them. (25)

2. What is a Convention Parliament ? How does it differ from an ordinary Parliament ? Give the date of one in the portion of history for your year ? (30)

3. Who was William of Orange? What events led to his becoming King of England? (25)
4. What arrangements were made for the succession of the Crown in William and Anne's reigns? (25)
5. Give an account of the military exploits of the Duke of Marlborough? (25)

Teaching.

MALES AND FEMALES.

(*Answer two questions only.*)

1. Write notes of a lesson on *Pronouns*, *A Town*, or *A country walk*, the two latter being taken for Second Standard Geography lessons.
2. Describe the use of sand or clay for models in teaching Geography to Second Standard.
3. What apparatus do you use when you are giving a lesson on colours to infants? State how you use it.
4. Write some specimen questions for Third Standard Mental Arithmetic or the First Class in your Infants' School.

END OF FOURTH YEAR.

FIRST PAPER.

(*Three and a half hours allowed.*)

Euclid.

MALES ONLY.

(*Answer two Questions, including Question 3 if you can.*)

1. If a straight line be divided into two equal, and also into two unequal parts, the rectangle contained by the two unequal parts together with the square on the line between the points of section is equal to the square on half the line. (20)
2. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts together with twice the rectangle contained by the parts. (20)
3. Enunciate the proposition which proves that the area of a triangle is represented by half the rectangle, which has the same base and altitude, and write out the definitions of the Second Book of Euclid. (30)

Algebra.

(*Answer two Questions, including Question 3 if you can.*)

1. Express in its simplest form—

$$\frac{\frac{1}{x^4 + x^2y^2 + y^4}}{\frac{1}{x^2 + y^2}(x+y)} \times \frac{x^2 - y^2}{x - y} \quad (20)$$

2. Find two consecutive numbers, the difference of whose squares is three times the square of their difference. (20)
3. Solve the equations :—

$$(a) \begin{cases} \dfrac{a+b}{x} + \dfrac{a-b}{y} = a^2 \\ (a+b)\,x - (a-b)\,y = 0 \end{cases}$$

$$(b) \quad \frac{x + 2b}{a} = \frac{a+b}{x+3b} \quad (30)$$

Mensuration.

1. What is the area of a circle whose diameter is 11·575 inches? (20)
2. Find the area of a regular octagon whose side is 11·4 inches. (20)

Arithmetic.

FEMALES ONLY.

(*Answer three questions only.*)

1. Find the simple interest of £650 for 3 years 73 days at $2\frac{3}{4}$ per cent. per annum. (30)
2. What is the discount on a bill for £923 due eight months hence at 4 per cent. per annum? (30)
3. At what rate per cent. will £45 amount to £48 7s. 6d. in six years? (30)
4. Define interest, proportion, discount, and commission. What is the compound interest on £150, payable half-yearly, at 5 per cent. for two years? (40)

Grammar.

MALES AND FEMALES.

(*Answer questions 1 and 2, and two other questions.*)

1. *Sweet* was her *breath as* the *breath* of kine *that feed* in the meadows,
When in the *harvest-time* she *bore* to the reapers at noontide
Flagons of home brewed ale.
Analyse the above passage. (20)
2. Parse the words in italics. (20)
3. Give examples of the use of words as two or three parts of speech. (20)
4. State of what principal languages the English language is composed. Give the proportions of each. (20)
5. Write out any six Latin words you know, and give examples of three words derived from each.

Geography.

(*Answer three questions only.*)

1. Draw a full map of Africa, South America, or India. (30)
2. Write a short description of the physical features of North America. (25)
3. What are the chief vegetable and mineral products of South America? (25)
4. Compare the Atlantic and Pacific Oceans. (25)

SECOND PAPER.

(*Two and a half hours allowed.*)

(Needlework for Females. *One hour.*)

Arithmetic.

MALES ONLY.

(*Answer three questions only.*)

1. Extract the square root of $\frac{4}{7}$ to six places of decimals, and the cube root of 18,609,625. (30)
2. If wine cost 15s. per gallon, how must it be sold per pint to lose $21\frac{1}{4}$ per cent.? and how so as to gain the same? (30)
3. Divide 240 into two parts so that $\frac{1}{3}$ of one added to $\frac{1}{10}$ of the other shall equal 36. (30)
4. If the three per cents. are at $98\frac{1}{4}$, and I sell out £1,575 stock, paying brokerage, and invest in the 4 per cents. at $107\frac{1}{2}$, what change will there be in my income? (40)

History.

MALES AND FEMALES.

(*Answer three questions only.*)

1. Give a short account of the doings of the Convention Parliament. (25)
2. What was the Mutiny Bill? What are some of the indirect results of the Mutiny Bill? (25)
3. Write an account of one of the attempts to deprive the Hanoverian king of the English throne. (25)
4. What led to the union of the English and Scottish parliaments? Name the chief articles of the Union Bill. (30)

Teaching.

(*Answer two questions only.*)

1. Write notes of a lesson on (*a*) the common pump; (*b*) the election of a member of parliament; (*c*) the climate of England.
2. Describe a good reading lesson.
3. Write six lines of poetry from your year's recitation, and show how you would explain it to a class.

For Teachers in Infant Schools.

1. Write notes of a lesson on (*a*) a daisy, (*b*) the goat, (*c*) a tea cup.
2. Give a number of specimens of questions in mental arithmetic suitable for the oldest children in an infant school.
3. Set a copy in large hand for the First Standard. Show the faults you have noticed in making the letters r, s, t, d, f, and g.

A Lesson to an Advanced Class on Sidereal, Solar, and Mean Solar Days.

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INFORMATION ARRANGED IN LOGICAL ORDER.

A. Simple Notions for recapitulation and Introduction.

1. The rotation of the earth upon its axis causes day and night.

2. The varying length of day and of night is caused by the earth revolving:—

   (*a*) Once a year round the sun.

   (*b*) With its axis inclined $23\frac{1}{2}°$ from the perpendicular to the plane of its orbit.

   (*c*) With its axis maintaining a constant direction.

NOTE:—Contrast the day above with the day as made up of the entire 24 hours and thus prepare for (B).

B. The Sidereal Day.

1. Suppose the earth to remain in the position of either Fig. 1 or 2, then a day, from noon to noon, would be the time required **for one complete rotation of the earth on its axis.**

2. Now if we examine a rotating globe E, so long as it remains in this position both S (sun) and B (a distant star) would be on a given meridian* always at the same time.

A **Sidereal** (or star) **day** would in this case coincide with a **Solar day.**

ILLUSTRATIONS AND TEACHING HINTS.

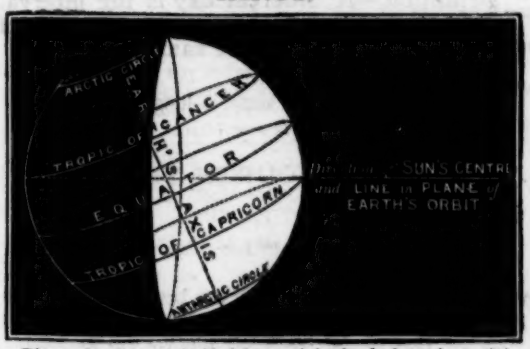


Fig. 1, showing one half of the earth in the dark, and remaining half in the light. Also the increasing length of day as we approach the south pole.

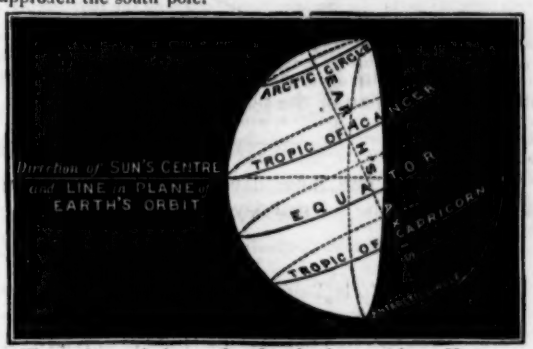


Fig. 2, the earth six months after the first position. Hence, on the opposite side of the sun; the axis, however, is seen to point in the same direction as in Fig. 1. The days now increase in length as we approach the north pole.

Fig. 3, to explain the difference between sidereal and solar days.

1. By the aid of a globe this statement is made evident.

2. With a globe simply rotating and not allowed to revolve this statement also is evident.

* For simplicity the meridian is here supposed to extend entirely round the globe.

3. During one rotation, however, the earth travels forward in its orbit to a position E_2 but the star being so far away appears on the meridian again when the place C has been carried round once by a complete rotation of the earth, and takes up the position marked C′ in E_2. **The interval required for this rotation to be completed is a Sidereal day.**

Definition.—A Sidereal day is the interval between two successive appearances of a given star over the same meridian.

It is always the same in length.

C. Solar Day.

When a place A on E_1 has been brought to A′ on E_2 the earth has made a completed rotation.

The time interval of a sidereal day has elapsed, but A′ must be carried by the earth's rotation to D before the sun is again on the meridian of the place. Hence:—

1. The Solar day is always longer than the sidereal day.

2. It is longer by the time occupied by the earth in rotating through the angle A′ED, or the angle equal to it, viz. DSA.

3. Thus we see that the lengthened Solar day in comparison with the Sidereal day is due, in the first place, to the amount of movement of the earth in its revolution round the sun.

Definition.—The Solar day is the interval between two successive appearances of the sun on the meridian of a given place.

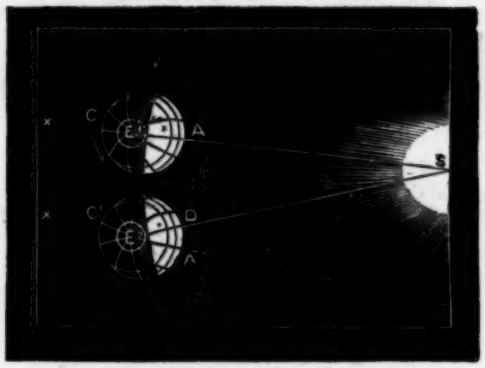
D. Mean Solar Day.

1. It has been shown above, that the lengthening of the solar day over and above that of the Sidereal day is due **to the movement of the earth in its orbit round the sun.**

3. The class must be told that the lines drawn from E_1 and E_2 to the distant star are parallel.

In illustration show that the two sides of a triangle become more nearly parallel the further the apex is removed from the base.

With the two lines E_1 and E_2 parallel, it will be seen that a sidereal day must be as stated in the definition.



By use of a rotating and revolving globe lead the class to see that the interval of rotation from the position A to A′ is equal to that from C to C′. Then ask the class to state the amount of rotation required for the sun to be again on the meridian of A.

1. In this way the difference between a Sidereal day and a Solar day may be shown.

2. The amount of difference should be stated from a careful examination of the diagram.

3. The equality between the angles A′ED and DSA must be shown by reference to geometry.

Do not form the definition until the above notions are grasped by the class.

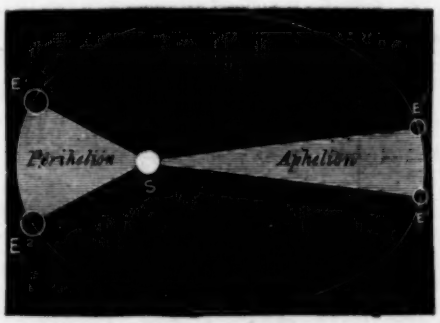


Fig. 5, showing the different rates of movement of the earth in Perihelion and in Aphelion.

1. Has already been explained and hence may be stated without further explanation.

2. The amount of this movement **varies from day to day.**

3. One reason is as follows: In our winter the earth is nearer the sun than in summer, and when nearer, *i.e.*, in Perihelion **it moves more quickly in its orbit than when it is farthest away**, *i.e.*, **in Aphelion.**

Hence the Solar day varies in length and the necessity arises for a **Mean Solar day.**

The Mean Solar day is the average of all the Solar days throughout the year.

2. This statement is made first by the teacher and afterwards explained by the aid of the above diagram and a reference to the laws of gravitation.

3. The necessity may be impressed by reference to watches and clocks which are made to keep regularly the same interval of time and therefore could not be made to keep Solar time. Now ask what time they keep?

The mean Solar day is the day indicated by our watches and clocks.

BLACKBOARD NOTES.

1. Day and night are caused by the **Rotation of the Earth on its axis.**
2. The variations in the length of day and of night are due to the earth revolving round the sun with an axis inclined constantly in the same direction, and at an angle of 23½ degrees.
3. **The Sidereal Day** is the interval between two successive appearances of a given star over the same meridian.
   It is always the same in length.
4. **The Solar Day** is the interval between two successive appearances of the sun on the meridian of a given place.
   It is always longer than the Sidereal Day.
   It is not always the same interval of time.
5. **The Mean Solar Day** is the average of all the Solar Days in a year.

Science Notes.

Sir James Paget's address on Study has attracted a good deal of attention, though not more than it deserved. He reminded his hearers what might be acquired by a scientific training—power of observing with accuracy, perception of the difficulty of attaining a real knowledge of the truth. The first thing to learn, he said, was the power of observing, the power of seeing things in their relation to other things and the modifications they might undergo. This was a difficult thing as was proved by the discoveries that had been made. Variations were occurring every week, but only the discoverer detected them. Another pregnant sentence should not be passed over lightly. 'In all scientific study a student should not only read the best manuals on the subject but at least one of the works of the best masters on the subject.'

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The Science and Art Department will introduce some changes into next edition of the Directory.

The Practical Geometry of the 2nd grade (Art) will be amalgamated with the Science subject known as Practical Plane and Solid Geometry. It is also gratifying to learn that a new alternative subject of Elementary Physics will be formed for those students who do not propose to continue their studies further in this branch of Science, but to whom an elementary knowledge of Physics is necessary to enable them to pursue their studies in other subjects with advantage. The Syllabus will include some portions of the subjects treated in the elementary or first stage of 'Sound, Light and Heat,' and of Electricity and Magnetism. We are sure this is a step in the right direction. The success of the alternative subject in Chemistry has doubtless encouraged the department to add one on Physics. When both these alternative subjects are fairly launched, it will be easy to make a regulation that no pupil should be examined in Physiology, Physiography or Botany who has not already passed the examination of the Department in these two very important subjects. We feel sure if this were done many of the examiners' complaints would be heard no more of.

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In his annual address to the Royal Microscopical Society, the President, Dr. Dallinger, called attention to the monads usually known as putrefactive organisms. There could be no doubt, he said, that the destructive process of putrefaction was essentially a process of fermentation. Alcoholic fermentation is rendered impossible if the presence of torulæ be excluded and in a similar way a putrescible liquid will remain absolutely without trace of decay no matter what length of time may be suffered to elapse if only it has been absolutely sterilized and placed in absolutely pure air.

As in the alcoholic, lactic or butyric ferments the process set up is shown to be dependent upon and concurrent with the vegetative processes of organisms characterising these ferments, so it can be shown with equal clearness and certainty that the entire process

of what is known as putrescence is as equally and absolutely dependent on the vital processes of a given or discoverable series of organisms. Each of this series does a part in the work of fermentive destruction, each aids in splitting up into lower and lower compounds the elements of which the masses of degrading tissues are composed, while each in turn takes up what is necessary for its growth and multiplication and so renders the pabulum fit for its immediate successor. There can be no doubt whatever that the pioneer in putrefaction is *bacterium termo*. Exclude it and you can obtain no putrefaction. Fermentation being set up, noxious gases are evolved, and in a week or so other forms such as those of *sporillum* begin to appear. The way then by which Nature acts upon the vast masses of dead organic matter is not by *bacteria* alone, but by a series of fermentive organisms which arise and succeed each other, the earlier ones preparing the pabulum or altering the surrounding medium so as to render it highly favourable to a succeeding form. In all these however, bacteria are the first and in many ways the most important series of destructive forms.

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THE effect of oil upon the surface of troubled water has long been known and has indeed passed into a sort of proverb. It seems that a small quantity spreads with great rapidity and acts practically as a breakwater to a ship in a storm. The amount of oil required is apparently very small. It is said that less than half-a-gallon per hour is enough to prevent the waves breaking over the largest ship. The practical application of this knowledge is yet only in its infancy. Considering the interests involved both to life and property one cannot too strongly hope that the matter will receive all the attention it demands and be the means of saving many of the terrible catastrophes that are now too common.

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A NEW method of determining the molecular weights of non-volatile as well as volatile bodies has just been published in the *Berichte*. It was discovered by Raoull. The method depends upon the lowering of the solidifying point of a solvent, such as water or benzene, or glacial acetic acid, by the introduction of a given weight of the substance whose molecular weight has to be determined. The amount by which the solidifying point is lowered is connected with the molecular weight M by the following simple formula: $M = T \times \frac{P}{C}$, where C is the amount by which the freezing point is lowered, P the amount of anhydrous substance dissolved in 100 grammes of the solvent, and T a constant easily determined for the same solvent by the use of a substance whose molecular weight is already known. It is expected that the method will prove very useful in checking molecular weights in the same way as the well-known generalization of Dulong and Petit.

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How to Teach School Children to Sing from Notes.

BY W. G. McNAUGHT,

Associate of The Royal Academy of Music.

CODE REQUIREMENT.

DIVISION II.—STANDARDS I. AND II.

NOTE TESTS.

To sol-fa slowly, from the Examiner's pointing to the Modulator, in any keys, the key tone and chord being given, the tones of the doh chord in any order and the other tones of the scale in stepwise succession.

13. In section 2 it was observed that the code requirements only roughly indicate a method of teaching. It is important at this stage to examine more in detail some considerations arising from this fact. The goal of all the efforts in Divisions I., II., and III., should be to teach in a most thorough manner the set of related sounds called the common major scale; the relations expressed by the names doh, ray, me, fah, soh, lah, te, doh^1. A grasp of these relations is very far from being implied by any amount of facility in singing up and down the scale.

Stepwise (that is, moving from one note of the scale to the next above or below) exercises have their uses in voice training, but to the would-be sight singer they are a delusion and a snare. Actual music is as full of leaps as it is of stepwise movement and you cannot teach these leaps by practising creeping.

14. To know the scale then we must be able to sing all possible leaps as well as all possible steps. How to go about this systematically is a question of method.

15. All the distances of tones from one another may be described in terms of interval. That is, these or those tones are said to be a major third, a minor sixth, etc., from one another. One method of teaching scale relations is to incessantly practise the various intervals until the peculiarity of each is impressed upon the mind's ear. When all possible skips are thus labelled and differentiated by the ear, the pupil is considered to be fully equipped for his task. This is a very difficult method and is certainly not the Tonic Sol-fa method. A select few, gifted with much more than ordinary capacity, with ample opportunities for practice, and with skilled attention, can on this method learn to sing; but for the great masses of children in our schools, taught as they must be by teachers who cannot claim to be specialists, such a method is certain to result in discouragement and failure. It is not asserted that the study of intervals is useless: on the contrary, such a study is indispensable to the musical student; but it has no practical bearing upon an elementary course of singing.

16. The Tonic Sol-fa method of teaching the scale is distinguished by two principal features. First, the grouping of sets of tones into Chords is the foundation of the *order* in which tones are introduced; and second, the remarkable fact that each tone of the scale has a peculiar effect, is utilised from almost the first lesson. It is to be feared that many school teachers who have only partially studied the Tonic Sol-fa system, attempt to teach it without having grasped the leading principles of its exposition of musical facts. They teach the notation but not the method.

17. The tones *doh* and *me* chord well together, so do *me* and *soh*, so do *doh*, *me* and *soh*. This combination is called the chord of DOH. Similarly chords can be built on any scale note by adding notes a third apart: *e.g.*

s	l	t	d^1	r^1	m^1	f^1
m	f	s	l	t	d^1	r^1
d	r	m	f	s	l	t

The chords set in thick type are the most important. They will be seen between them to include all the tones of the scale.

		r¹
d¹	**d¹**	
		t
l		
	s	**s**
f		
	m	
	d	

These three chords form the three first steps of the Tonic Sol-fa method.

Doh or Tonic Chord	1st step.
Soh or Dominant Chord	2nd step.
Fah or Sub-dominant Chord	3rd step.

Doh and soh each belong to two chords. When the tones of a chord are sung in succession instead of in combination they are still called chords, and in whatever order they occur, they exemplify the chord: *e.g.*—**d m s**—**m s d¹**—**s d m d¹** or **s r¹ t**—**s r t**—**t r¹ s**—**d f l**—**l f d¹**—**d¹ f l**. Some orders of arrangement are easy to sing, some difficult. The difficult successions in the doh chord were noticed in sec. 7. Difficult leaps in the other chords will be noticed as occasion requires.

18. The mental effects of the various tones of the scale are described in almost every Tonic Sol-fa instruction book. They need not be recapitulated here. The method of utilising them alone calls for remark. Children should not be expected to be able to describe correctly the mental effects of tones sung to them. These effects should be the subject of *repeated* and *varied* demonstration. The ingenuity and resource of a teacher must be continually drawn upon to provide vivid and picturesque illustrations. Hints on this point will be given as the tones of the scale are dealt with in turn.

19. One other important principle of teaching adopted in the Tonic Sol-fa method must be mentioned before going into details. This is the principle that a teacher should *pattern* to his pupils—he should sing *to* them and not *with* them. Apart from the fatigue thus avoided the advantages of this plan are numerous and important; the teacher can be heard better by the pupils and he in turn can clearly hear them, and the pupils learn to be independent. Some teachers almost unconsciously 'help' their pupils over all difficulties by singing with them even when pointing a modulator exercise.

20. It is not meant by the foregoing to recommend the teacher not to use stepwise exercises. What he has to do is to combine chordal and stepwise exercises and to illuminate his practice by repeated references to mental effects. Filled with these ideas we can discuss the scale tones now to be taught.

21. *Te* and *Ray* (making, with *soh*, the SOH chord) are the tones to be taught in the second step. According to the intelligence of the class the discerning teacher will adopt this or that method of presentation.

22. *Te* may be introduced on what we will call the (*a*) method. The class is asked to discover when a sound not **d m s** or **d¹** is introduced. The teacher promises to sing to *laa* several tones of the DOH chord and *perhaps* a new note. He then sings say **d m s m d**, and **d m s d¹**, and **d m s s t d¹**, each time questioning the pupils. When it is fairly agreed that the new note has arrived, its peculiarity may be studied. The teacher may sing (still to *laa*) **d m s s** $\overset{\frown}{\mathbf{t}}$ and ask the children to decide whether the last tone calls for more or whether it sounds finished. Then the name may be given and the following phrases sung from the blackboard 'modulator' which so far should show just the tones known or being studied and no others. Each phrase should be first patterned—(1) **d m s m** (2) **s t d¹** (3) **s s m m s t d¹** (4) **s t t d¹** (5) **d m s s** $\overset{\frown}{\mathbf{t}}$ **d¹** (6) **d¹ t d¹** (7) **d¹ s t d¹**. Many other similar exercises will be found in Curwen's books. The hand sign may now be introduced to deepen the impression made. The sign for *te* is one of the best of the series. It is so singularly appropriate and suggestive.

23. A more dogmatic form of introduction may be necessary for some classes. We will call the following the (*b*) method. The teacher promises a new name and a new tone at once and asks pupils to hold up hands when they hear the new comer. He then sings the foregoing exercises to the Sol-fa names.

24. Ray having been introduced on the (*a*) or (*b*) methods, using say such phrases as (1) **d m s m r d** (2) **d m r d** (3) **d s r d** and, of course, the name added to the blackboard modulator, the best method of exercising the class in all the tones learned must now be considered. The teacher must learn to make good voluntaries.

25. A voluntary is an exercise made up by the teacher and pointed on the modulator. Very much depends upon the teacher's skill in making fresh but not too difficult voluntaries. The greatest danger is that of falling into a stereotyped style, a practice of pointing the same succession over and over again, *doh* always being followed by *me* and that by *soh*, *ray* always leading to *doh*, etc., etc As in the effort to avoid monotony he may stumble on great difficulties it is best for the inexperienced teacher to prepare his voluntaries beforehand. A voluntary should always have an intention and should not degenerate into a dry, uninteresting and perfunctory exercise.

(To be continued.)

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Publications Reviewed.

The Royal Upper Class Readers: Collier's Great Events of History. London: T. Nelson and Sons.

In this volume the publishers have re-issued, in a revised, enlarged, and greatly improved form, a work written several years ago by Dr. Collier. The object aimed at is to fill up the many gaps which often remain in the historical knowledge of students on leaving school for business and professional pursuits. The plan of the author is to select central points of interest, and describe the various events which cluster round them, so as to give a chain of the most important incidents in the world's history, from the Christian era down to very recent years. Thus, the centre of interest is at one time in Italy, at another in France, at another in Germany,—at Constantinople, in the Netherlands, in Palestine, in Spain. At the same time, by connecting tables and summaries, the element of continuity is not lost sight of. The style of the chapters is picturesque and attractive, and indeed in many passages it may be properly pronounced brilliant. All the modern collateral aids supplied in the best reading books are present here—chronological and other tables, biographical and geographical notes, maps and illustrations; and all are good of their kind. Such a work, dealing as it does with great men like Charlemagne, Charles the Fifth, Louis XIV., Peter the Great, Frederick the Great, and Napoleon; and with such great movements as the Foundation of the Roman Empire, the Crusades, the Reformation, and the French Revolution, cannot fail to be appreciated by those who have a taste for historical reading, and is eminently suitable for the upper classes of middle class and other schools, and also for pupil teachers and advanced scholars in elementary schools

The Royal Upper Class Readers: Great Authors, from Macaulay to Browning. London: T. Nelson and Sons.

We have here another school reading book worthy of the highest praise. It forms one of a series for the purposes of which modern English literature is divided into three periods. The second period, extending from Goldsmith to Wordsworth, was dealt with in the first volume, which we recently noticed. The third period supplies the material for the second volume, which is now before us. And the first period, including Spenser, Shakespeare and Milton,—and therefore requiring more advanced knowledge for its due appreciation—is very properly reserved for the third volume. The present book contains pleasantly written biographies of Macaulay, Carlyle, De Quincey, Ruskin, Dickens, Thackeray, Tennyson, and Browning among English writers, and the two great representative American authors, Irving and Longfellow. The literary work of these eminent men is admirably illustrated by well-chosen selections of sufficient scope and variety to give a good idea of their style. A further result of judiciously using this book will be to implant and foster a desire to become better acquainted with the works from which the selections are made. The paper, type, and general appearance of the volume are all alike attractive.

Exercises in English Word-Formation and Derivation. By Frank Ritchie, M.A. London: Swan, Sonnenschein, Lowrey and Co.

This is a little book of exercises only; but it contains such a variety of exercises on the formation and derivation of English words, that it would be difficult to find new and useful forms of test to supplement the work of Mr. Ritchie. On every page appear copious lists of words to be dealt with according to the requirements printed at the head—as nouns to be given corresponding to verbs, allied verbs and adjectives, frequentatives, diminutives, force of prefixes and affixes, contrary meanings, roots of words, derivatives from roots, cognate words, divergent meanings, synonyms, phrases, abbreviations, alternative spellings, and many others. The book, which is marked by an entire absence of any words of introduction as to the mode of using it, is nevertheless likely to be very serviceable in saving teachers' time and trouble in framing suitable exercises on an important part of the study of language.

Health Maps. By Anna L. Arnim. London: Swan, Sonnenschein and Co.

These health maps, as they are called, are diagrams of gymnastic exercises intended to strengthen the various parts of the human body and preserve it in a state of health. There can be no question of course as to the importance of physical exercise any more than there can be of fresh air and good food. It is however painfully manifest that in crowded towns the young people find less and less opportunity for outdoor exercises, or indeed for any suitable exercises at all. For such any systematic drill would be a real boon. But it must be admitted that what is most wanted is the ability to teach a rational system of drill to the young persons, who would gladly enough benefit by it. The idea of gymnastic training is to some extent novel, and has not yet spread very widely among the people of this country. We therefore welcome this new and rather elaborate attempt to popularise the subject on a wider, though apparently, a private scale. These maps can be bought, and persons can by a little attention see the sort of exercises that will be most likely beneficial to them, and then practise them for a few minutes each day for themselves. We have some doubt as to this practice becoming very general. The English people are very conservative, and change their habits slowly. None the less we wish success to these maps. They will be useful, and when they are better known they will be more appreciated and more widely circulated.

A Critique of Kant. By Kuno Fischer. London: Swan, Sonnenschein and Co.

Students of Kant, and there are not too many of them, though an increasing number truly, have all heard of Kuno Fischer. His great work on the History of Modern Philosophy was for a long time mostly inaccessible to English students. The 'Critique of Kant,' which gives the main results of the two volumes on Kant in the history, together with the author's criticism on the Kantian doctrines, are now presented to the English public in a handy volume of less than 200 pages. Those who are interested in this great thinker's work, so important in itself, and especially so for us at this time, cannot do better than read Professor Fischer's criticism in its English dress. The difficulty of the subject itself is sufficient for most of us, without the additional incumbrance of a foreign language. We have no doubt this volume will be graciously received by those who have made a study of any of Kant's great works.

Ants, Bees, Dragon-flies, Earwigs, Crickets, and Flies. By W. Harcourt Bath. London: Swan Sonnenschein, Lowrey, and Co.

In this little volume, one of the 'Young Collector' series, Mr. Harcourt Bath has attempted the impossible; to give an account of five of the principal orders of insects, with numerous illustrations, in the compass of 108 octavo pages, were as feasible an undertaking as the endeavour to compress Lake Windermere into a teacup. All that the author has succeeded in doing is to enumerate the various tribes and families of the different orders, and to give a passing mention of some of the more typical species. In what manner the book may prove of value to the 'Young Collector' we cannot pretend to understand.

This is the more to be regretted, inasmuch as a popular work on the less familiar orders of insects is very greatly needed. A young entomologist, in taking up flies, ants, bees, or dragon-flies, finds absolutely no book to guide him during the earlier portion of his task, in which, of course, his need of help is the greatest. And even when he has made some progress, information upon his special branch of entomology can only be obtained by the purchase of expensive monographs, the great majority of which are written in what we may describe as the scientific vernacular of various continental languages. To supply such a book as is required the author of the little volume before us has no doubt done his best; and we can detect but two or three very trifling errors in that which he has written. But he has been hopelessly handicapped in his undertaking, firstly, by the vast extent of his subject, whose students are numbered as yet by units only; secondly, by the exceedingly narrow limits of space assigned; and, thirdly, by the necessity which has obviously been forced upon him of employing a large number of woodcuts without any reference to the letter-press. The book is profusely illustrated—there are 156 figures in all—but not one-third of the insects depicted belong to British species, while even of those which are given a large proportion are familiar to the veriest tyro in entomology. Reluctant as we are to say aught but in praise of a book which aims to supply a long-felt want, we fail entirely to understand how the little volume before us can prove of the slightest real utility to anybody at all. It is too scientific and general for the beginner, too superficial for the more advanced student; and therefore the number of readers who can obtain any benefit from its pages must necessarily be very small indeed.

Jones's Standard Arithmetic. London and Manchester: John Heywood.

This was among the first of the books for the standards, consisting of examples only in arithmetic. It supplies a very large number of exercises, suitable for mechanical work in the various standards.

A System of Practical Arithmetic. By Samuel Young. John Heywood.

This is just and only what the title pretends it to be, viz., a Practical Arithmetic; full of rules, tables, and examples.

It is intended wherewith to prepare lads for the actual arithmetical operations they may have to perform after they leave school—*e.g.*, on page 181 we find this question: What weight will be required to break a beam of English oak, the breadth being 3 inches, the depth 6 inches, and the length 20 feet? Looking at the rule we find 'The product of the tabular number in Col. S (which we will explain directly), the breadth and the square of the depth in inches, divided by the length in inches, will give the weight in lbs.' Col. S is the tabular statement of multiplicands for the transverse strains of timber, which of course, varying for different woods, can only be found by actual experiment—that for E. oak being 1672.

We do not suppose for one moment that any lad in a surveyor's office would mind performing the above operation, in which accuracy of course is most important, when he knew that it was really required for practical purposes; but to work such examples at school, without having the slightest idea of a reason for any part of the working or in what way the mystic 1672 was found, is, we believe, not only a wasted opportunity of strengthening the reasoning faculties, but a performance so distasteful to the intellect as to positively do it harm.

We do not think it would increase the work to any very great extent, if some hints were given as to the reason for each rule.

We should not have made these somewhat strong remarks had we not read on the title-page that the work is prepared for schoolboys. Arithmetic is one of our best educational subjects if properly taught by intelligible teachers, but not one master in a hundred could explain such a rule as we have quoted so as to make it educational at all.

Ashman's Spelling Book. London and Manchester: John Heywood.

In this little book words are arranged according to their length. After easy words of one and two syllables and an exercise on the diphthongs, the chief plan of the book is introduced. This consists of alphabetical lists of words of one, two, three, and more syllables with their meanings in simpler words, where possible arranged in parallel columns. A successful attempt has been made to secure correct pronunciation by re-writing phonetically most of the difficult words. A list of the most common prefixes, suffixes, and roots is added. We think the design of the author, which is to make children better acquainted with the meaning of the words they meet with, will be answered by the use of the book; and in any case it will afford good practice in spelling, pronunciation, and the use of synonyms.

Dynamics and Hydrostatics. By R. H. Parkerton, B.A. London: Blackie and Son.

This is one of Messrs. Blackie's Science Text Books. It is excellent both in plan and execution. The aim of the author is to explain what is usually included in a first course of Dynamics, including Hydrostatics. The book is characterised by great clearness and accuracy. It is especially noticeable in important matters like definitions and units. The subject is also treated according to modern methods. All the important propositions are followed by examples fully worked out, and also by others which are left as practice for the student. The book is intended to be used by those who are beginning the study of the subject and are only able to follow simple mathematical methods. It will be found amply sufficient for such examinations as those of South Kensington, the Civil Service, and also for the Junior and Matriculation Examinations of the Universities.

Electrical Instrument Making for Amateurs. By S. R. Bossone. London: Whittaker and Co.

This is a small volume of 180 pages, well printed and illustrated. It is essentially a book for amateurs. To them it will be welcome indeed. To those who only want to read, but not to construct, it will be prosy and dull. The true amateur, says the author, as a rule, has not a large assortment of tools. Little by little he gets together or constructs those which are necessary for his purpose, but he seldom aspires to the complete paraphernalia of a workshop. Then we have a list of tools that are considered essential. They are not many, nor dear. With these the author begins. Detailed instructions are given for soldering; and to many persons the book would be worth buying if only to learn how to perform that very useful operation with moderate success. We can cordially recommend this book to any of that increasingly large number of persons who think the time has come to add practice to knowledge, and to spend a little of their spare time and energy toward rendering themselves more useful, independent, and self-reliant. But we repeat it, this is not a book to be read and put by. Only those who want to learn how to do something with their hands should buy it; others would be disappointed.

The Citizen Reader. By H. O. Arnold-Forster. London: Cassell and Company.

We had the pleasure of commending Mr. Arnold-Forster's Citizen Reader on its first appearance, two or three years ago. We notice it again, because it is an excellent example of the type of reading book we have often mentioned in this journal as having higher educational tendencies than the miscellaneous selections which form the ordinary school readers, and also for the purpose of expressing our satisfaction at the fact that it appears to have been so widely appreciated. We need not repeat our praise of the simple, straightforward, and telling style in which the book is written; but we ought to state that, in the present revised edition, statistics have been brought down to date, and additional explanations and some very good and suitable illustrations have been introduced.

Addresses by Edward Thring. T. Fisher Unwin.

We can conceive of few greater gifts in the cause of education than for a rich man to purchase a sufficient number of copies of this wonderful collection of thoughtful essays on the above subject, and distribute them to every teacher in the land, from the highest to the lowest.

Our space prevents our entering in to the special features of the volume as we should like, and as it deserves. Truly indeed, with such a legacy to the teaching world, 'he, being dead, yet speaketh.'

An Elementary Text Book of Physiology. By J. McGregor Robertson. London: Blackie and Son.

This is one of the series of Science Text Books now being issued by Messrs. Blackie. Students will find it a helpful, reliable book. We can recommend it very strongly. It professes to meet the requirements of the Science and Art Department, and of the local examination boards of the universities. The author has saved much space by giving an account of the facts and principles of Physiology, not in disconnected paragraphs, but woven into a continuous story.

The student is recommended to read the book through to begin with, with the object of gaining a general knowledge of the subject, and then afterwards limit himself to those parts of the subject which he wishes to study. This is no doubt sensible advice. We believe those who read and understand this book will be well prepared for many of the examinations held on the subject of Physiology, and will pass them with credit. It has, however, always

seemed to us that Physiology is a very difficult subject to master, and that to get it from books alone, however ably written, is to attempt the impossible. It leads to thinking we know, when we do not. Persons read about these physiological processes, about the wonderful apparatus by means of which we live and move and have our being. They are interested and even fascinated. But without some previous acquaintance with Chemistry and Physics, and without constant references to the organs and processes themselves, the study of Physiology as a scientific study of science is a delusion and a snare. By many people it is thought to be almost necessary to know something of Physiology. This is unfortunate. It is bad for Physiology, and worse for those who, by having passed an examination in it, are led to believe they know something about it, when in reality they only know the contents of a book.

The Characters in Hamlet and other important Shakesperian Plays delineated. By William Weeks. London: Thomas Murby.

It is much better that the student of Shakespeare's plays should gather his ideas of the characters by carefully reading the plays and reflecting on them, than that he should simply take his opinions about the characters at second hand. Still, the preparation for an examination is so often the chief motive of the student, and the stress of such necessity often makes it so difficult to adopt the best plan of study, that every kind of help is welcomed. And, indeed, no help is more worthy of welcome than such as Mr. Weeks affords in this little book of notes and extracts on the characters in Julius Cæsar, Coriolanus, Richard II., Macbeth, King Lear, The Merchant of Venice, The Tempest, and Hamlet; provided it be used as an appendix to such careful personal study as may be practicable.

The notes have been accumulated in the course of reading for the purpose of preparing second year students in a training college for the requirements of the certificate examination, and include valuable quotations from Gervinus, Coleridge, Hazlitt, Ulrici, Mrs. Jameson, Schlegel, Dowden, Hudson, Moberley, and other Shakespearian scholars. In this lies the highest value of the work, for most students cannot get access to the works of these authors, and here they have the most pertinent portions of such works collated for them by one who has done his work in a sympathetic spirit, and has made the result available in a convenient form.

Thom's New Reading Books: First Primer, Second Primer, Infant Reader. Dublin: Alexander Thom and Co., Limited.

These little books are well adapted to the purpose of initiating infant pupils into the early stages of reading. The plan of teaching new words by similarity of spelling is adopted to a considerable extent; but we doubt the advisability of introducing such difficult combinations as *gnaw*, *gnat*, and *buy* in a first primer. The typography of the primers is remarkably bold and clear. The Infant Reader contains several of the childish poems of Jane and Ann Taylor, and a number of quaintly fresh fables. All the books are suitably illustrated, many of the woodcuts having the clearness and delicacy of pen-and-ink drawings. Some of the illustrations of the fables are exceedingly droll.

Moffatt's Handbooks for Students: Shakespeare's Twelfth Night. London: Moffatt and Paige.

Among the many editions of Shakespeare's Plays for students preparing for examination we know of none in which the methodical arrangement of various kinds of help has been so thoroughly carried out for the student's convenience. The book begins with a page of discussion on the 'Date of the Play.' Next comes a page on the 'Sources of the Plot.' This is followed by a 'Sketch of the Plot,' a plainly written narrative, which states in due order all the incidents of the play. The text is printed with a rather wide margin on the right of each page, and in this are placed short explanations of certain words, which are distinguished by italics. These explanations are generally of the nature of synonyms; they seem to be quite sufficient for their purpose, and are likely to be useful in paraphrasing. After the play we find a large amount of information classified under separate headings. First, a series of 'Miscellaneous Notes' to explain curious or difficult expressions referred to by numbers in the text; then 'Notes on the Language of the Play,' given in alphabetical order, instances of grammatical peculiarities, with quotations, references, and explanations; next, several pages of 'Etymological Notes,' which supply the derivation of the note-worthy words. 'Proper Names' are given with explanations of the allusions to them; paraphrasing and analysis are illustrated by examples; and the book ends with carefully written sketches of all the important characters, and 'Literary Notes,' quoted from such Shakespearian critics as Hazlitt, Mrs. Jameson, Charles Lamb, and H. N. Hudson. This detailed statement of its contents shows how methodical and complete are the idea and arrangement of this handbook, and it only remains to add that the whole of the work appears to be thoroughly well done.

The Standard Algebra. Enlarged Edition. London and Edinburgh: W. and R. Chambers.

This is a thoroughly practical book of 104 pages, covering two stages of the specific subject, algebra of the code. The explanatory part is clear, full, and accurate. Many illustrative examples are worked out in full, while the exercises, some two thousand in number, are all original. The chapters on general results in multiplication and resolution into factors are now considerably enlarged, and forty test exercises have been added. From personal knowledge of the book, we know that results obtained by its use are thoroughly good. It has our hearty commendation.

Practical Geometry for Art Students. By John Carroll. London: Burns and Oates.

This book embraces the whole of the work required by the second grade art syllabus of the Science and Art Department, and will be found equally serviceable under the new regulations for the D. certificate. It is thoroughly practical and cheap. No private student needs a better book, and no teacher could place a more trustworthy text book in the hands of his pupils.

New Standard Drawing Copies. London: Cassell and Company.

This series of drawing books for the new drawing schedule is now completed by the issue of two books for each of Standards V. and VI., and four books for Standard VII. The freehand copies for Standard V. are very bold and clearly drawn, while the practical geometry book leaves nothing to be desired either in the figures or the letterpress. The same may also be said of the books for Standard VI., the series of examples in the solid geometry for this Standard being very carefully and suitably graduated. To compass the work of Standard VII. will need all the time which a teacher can find for the subject. The freehand is equal in difficulty to that required for second grade art, while the requirements in solid geometry go beyond those for the same grade. If, however, the work can be got through, it will be by the aid of these capital books. The twelve last of the series consists of exercises in shading. The cube, cylinder, sphere, various prisms, and the cone, are the subjects of the exercises, and the process of shading is carefully developed; but the principle on which the shadows are formed is left entirely to the teacher. They are good copies; and pupil teachers and others who have not had much practice in shading, would do well themselves to use the book as an introduction to more extended work.

Poynter's Drawing for the Standards, Books 13, 17, 18, 21. London: Blackie and Son.

Messrs. Blackie continue the production of this good series of drawing books. Book 13 forms part of the work Standard IV. The instructions for the formation of scales are very full, but the language is somewhat difficult for the ordinary fourth standard child. Some of the examples in the book are also rather advanced. Books 17 and 18 cover the geometry required by the schedule for the fifth Standard, and are suitable for the purpose. In practice, the figures should be much larger. Book 21 continues the instruction in model drawing already introduced in books 11 to 16. A scholar who has fairly mastered the contents of these books will be well prepared to attack models themselves, while the teacher has in them capital examples of blackboard copies for class teaching purposes.

Australasia. By W. Wilkins. London: Blackie and Son.

In a book of 252 pages, Mr. Wilkins has given a full descriptive account of our Australasian colonies and the adjacent lands. It is intended principally as a reading book for advanced classes, and it might also be used with very great advantage by the pupil teachers, whose course of geography includes the British Colonies. The book has upwards of forty illustrations and is prefaced by a map fully coloured, while maps in black and white are interspersed throughout the text. Although not intended as an ordinary text book, we know of no book intended for a similar purpose containing such a mass of information brought down to the latest date. It is written in a pleasant, agreeable style, and the various items of information being given in the same order for each of the colonies, it will serve as a ready book of reference for those whose leisure does not permit them to make themselves fully acquainted with the geography of that part of the world of which it treats. No intending emigrant to Australia or New Zealand need be ignorant of the natural history and capabilities of the land of his adoption who carefully reads Mr. Wilkins' book. It has evidently been written by one well acquainted with what is expected in such a volume, and who is fully convinced of the great future which lies before the continent of the Southern Ocean.

Albert, the Prince Consort. By G. Holden Pike. Messrs. Hodder and Stoughton.

We must congratulate Mr. Pike on the way in which he has compressed into 228 pages so much interesting matter about this good and great man.

The work is divided into ten chapters, which are almost essays in some cases, on the different phases of the Prince's character and life; *e.g.*, we have a chapter headed 'The Friend of the Poor,' and another 'His Christian Life.' True, there is one chapter of a somewhat different character, viz., that which is devoted to the Great Exhibition of 1851.

The author has had permission to draw from Sir Theodore Martin's standard work on the same man, but we are assured there is a great deal of original matter in this volume.

The book ought to be of use to many, young and old, rich and poor,—all in fact who wish to live the life, which it is in the power of all to live, viz., that one that is of advantage to all they come in contact with, whether their lot be high or low, and accompanied or unaccompanied with riches.

A New Testament Primer. By Edward Miller, M.A. Clarendon Press.

This is an admirable little book, thoroughly well adapted to its purpose, which is not to teach the Greek language, but to enable zealous students of the sacred books, who have not had the advantage of a classical education, to read these books in the tongue in which they were written. In 63 pages the essential parts of the accidence are clearly set out. There is then a very short syntax of 10 pages, in which the illustrations from the Greek are all selected from the New Testament. The rest of the book, about 60 pages, consists of a reading primer with vocabularies. The sentences are at first remarkably easy; they increase in difficulty, and finally the student finds himself translating consecutive passages from the easier chapters of the New Testament. We are pleased with the book. It is likely to be very useful to the rather large number of persons who would like to read the New Testament in the original, but have not had the advantage of a grammar school education, and who do not intend to read the Greek authors. The usual introductions to Greek, excellent as they are for those who are proceeding to the higher parts of the subject, are needlessly difficult and discouraging.

There is a shorter way for them, and we believe in this book it has been found. We hope it may be widely circulated and seriously studied.

Magnetism and Electricity, for the Matriculation of the University of London. John Bowick, B.A., LL.B. Stewart and Co.

This little book of 126 pages is an attempt to put in as concise a form as possible the matter required in magnetism and electricity by the University of London for matriculation under the new regulations. The book is clearly written and well illustrated. Questions are given at the end of the chapters. There is nothing strikingly original in the method of treatment. We presume it is intended to be used as a text book, the experiments being carefully done by a teacher. There are no directions for the pupil to do them for himself, and some of the illustrations might have been simpler if the pupil is to be student and teacher in one. The electroscope on page 43 is of a truly wonderful shape. A few simple directions would enable a boy to make an electroscope for himself which would be both sensitive and useful. As a statement of facts and theories the book may be recommended. It is not a practical guide, and, to do the author justice, he does not pretend that it is.

Notes on the Early Church. By Rev. R. O. Thomas, F.E.I.S. Thomas Murby.

This little volume is prepared for theological students and others. It covers the period from 64 to 500, but at the beginning we have a valuable introductory sketch as to the condition of the nations of the world at the birth of Christ.

This chapter includes, amongst other things, the teaching of the different philosophical sects, concluding with the principles of the Gnostic Philosophy.

At the end of each chapter, which correspond to the centuries, there is a *résumé* for self-examination, and at the end of the little volume there are some 64 questions on the subject, extracted from University and Ordination Papers. We venture to think these questions might be multiplied with great advantage, and a few model answers given.

What Books to Lend and What to Give. By Charlotte M. Yonge. National Society.

This book is a very happy thought of the gifted and learned writer whose name it bears.

Truly does she say, Books are a necessity among the appliances of parish work. If boys and girls and young men and women cannot get good healthy books they will get bad ones, hence the necessity for care in the matter.

There is a very able distinction drawn between the kind of books to lend and the kind to give; the latter, the writer says, which are read and re-read and passed on to younger generations of brothers and sisters, and sometimes children, should be more carefully selected than the former, and should always contain some solid valuable advice.

The work is divided into a good many chapters, such as Little Ones, Boys, Mythology, Penny Readings, and at the end of each chapter there is a list of suitable books for such, and these books are all numbered, the

numbers being referred to in an index; *e.g.*, supposing one has a copy of 'Rab and his Friends' to give away, one looks it out in the index and finds the number 924 attached to it; in turning to 924, which we easily find on page 113, we there see it is considered a suitable book to be read to people at Penny Readings.

We cannot recommend the book too strongly.

—o—

THE Royal Geographical Society have now made their first awards to Students in Training Colleges in accordance with the decision of the Education Department. The Council of the Society offered ten prizes, five to the male students and five to the female students in the colleges in England and Wales. The first prize in each series is a Scholarship value Fifteen Pounds. Mr. J. W. Goodgere, of the Borough Road, and Miss A. E. Alexander, of Whitelands, have obtained these scholarships. Four prizes, to consist of books, are awarded to Mr. F. Baker, Cheltenham; Messrs. H. Grover, Battersea, and J. E. Quarfe, Borough Road, bracketed equal; and Mr. A. J. Berry, Battersea; and four others to Miss A. Eve, Bishop's Stortford; Miss K. Charlton, Lincoln; Miss J. Jones, Warrington; and Miss G. Martin, Chichester. The male competitors are in their first year of residence, as geography is not now generally taken during their second year of training; but the female students gain these prizes at the close of their College course. The almost absolute failure, after an experience of sixteen years, to stimulate the study of geography in the great public schools by the annual award of medals induced the Royal Geographical Society to discontinue these awards in 1885, and the diversion of their funds for the benefit of those who directly influence the masses of the people is more likely to secure the object chiefly desired. The scheme as affecting teachers is capable of extension and possibly, by the co-operation of the Department, pupil teachers may hereafter find during or at the close of apprenticeship valuable prizes as rewards for their study of geography. The British people should not be ignorant of a subject so helpful to commerce, and any effort on the part of the Royal Geographical Society to popularise the subject is worthy of commendation and support.

The 'Practical Teacher' Sale and Exchange Column.

Owing to numerous requests, we have been induced to start this Exchange Column for the benefit of our readers. We shall be glad to insert announcements relating to the 'Sale or Exchange' of books, etc., at the rate of ONE PENNY PER LINE, *prepaid.*

On Sale.—PRACTICAL TEACHER, Vols. V., VI., VII., in Parts. II., III., IV. half-bound leather, Vol. I. publisher's cloth; all very good condition.—D. B., Park Place, Keighley.

For Sale.—Student's Hume, 3s. 3d.; Philips' 'Physical Atlas,' 3s. 3d.; 'German Principia,' Part I., 2s. 3d.; Lee's 'Acoustics' (Advd)., 1s. 6d.; Stewart's 'Physics,' 2s. 6d.; Huxley's 'Physiology,' 2s. 6d.; Prince's 'Physiography,' 9d.; Cassell's 'Dictionary of English History,' first five parts, 4d. each; Stock's 'Lessons on the Life of Our Lord,' 2 vols., 2s.; all in good condition; post free.—Apply A. Wilson, High Street, Maryport.

For Sale.—Hall and Knight's 'Algebra' (new), 2s. 6d.; C. Smith's 'Algebra' (new), 2s.; French Principia and Key, 2s.; Gax's 'First and Second French Courses and Key,' 2s.; Bennett's 'First and Second Latin Courses,' 2s.; Jackson's 'Practical Arithmetic' (new), Magnus's 'Mechanics' (new), Smith's 'Smaller History of England,' 'Principia Latina,' Part IV., Drew's 'Conic Sections,' 1s. 6d. each; Baume's 'French Grammar,' Elsee's 'Algebra,' Elsee's 'Arithmetic,' 'Matriculation English,' Daniell's 'Grammar,' Part I., 1s. each; Hunter's 'Key to Colenso's Arithmetic,' 2s. 6d.; all in excellent condition.—C. Russell, 76, Middleton Road, Dalston, E.

For Sale.—Virtue's 'Shakespere,' 40 2s. Parts, take 20s.; Blackie's 'Royal Portraits and Pictures,' 23 2s. 6d. Parts, take 37s.; Hamblin Smith's 'Geometry' (3s. 6d.), take 2s.; Todhunter's 'Algebra' (7s. 6d.), take 5s.; Wormell's 'Geometry,' take 1s. 6d. (last three never been used, quite new); or what offers?—Address—Schoolmaster, Boston Union, Lincolnshire.

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